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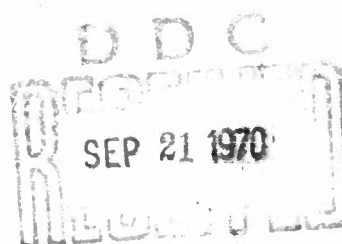
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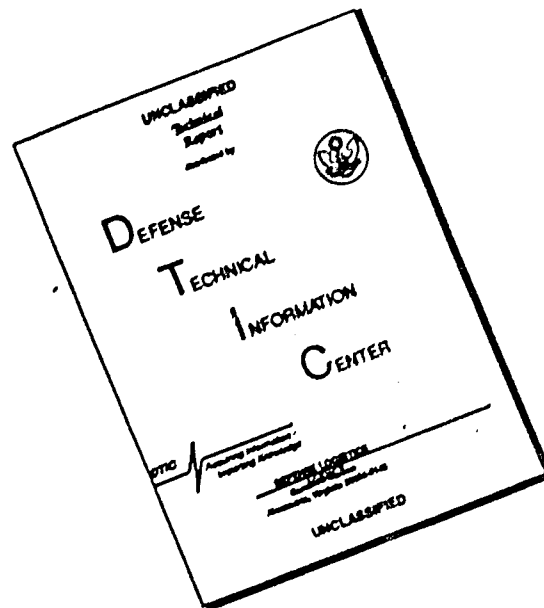
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In addition to the
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FINAL REPORT

"IROQUOIS NIGHT FIGHTER AND NIGHT TRACKER"
(INFANT)

ACTIV Project No. ACA-49/67IS

30 April 1970

APPROVED: 1 AUG 1970

Richard L. Clarkson

RICHARD L. CLARKSON
Colonel, ADA
Commanding

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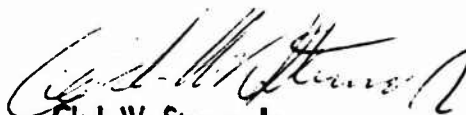
Headquarters, United States Army, Vietnam, APO San Francisco 96375 21 AUG 1970

THRU: Commander in Chief, United States Army, Pacific, APO San Francisco
96558

TO: Assistant Chief of Staff for Force Development, Department of the
Army, Washington, D.C. 20310

1. Subject final report is submitted for review and approval.
2. This headquarters concurs in the conclusions and recommendations; however, because of operational necessities and unit redeployments, the INFANT was organized into four platoons which were assigned to the 1st Aviation Brigade. One INFANT platoon will be employed in support of each Military Region in RVN.
3. Request one copy of all forwarding and approval indorsements be furnished this headquarters and all distribution addressees.

FOR THE COMMANDER:



Clark W. Stevens Jr.

Cap 001 000

Assistant Adjutant General

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THRU: Commanding General
United States Army, Vietnam
ATTN: AVHGC-DST
APO 96375

TO: Assistant Chief of Staff for Force Development
Department of the Army
Washington, D. C. 20310

1. References:

a. Letter, AGAM-P(M) (2 May 69) FOR ACTIV, Hq DA, 8 May 69, subject: Army Combat Developments and Materiel Evaluation (CD&ME) Program, Vietnam.

b. Letter, AVHGC-DI, Hq U.S. Army, Vietnam, 23 February 1967, subject: Letter of Instructions.

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FOR THE COMMANDER:

1 Incl
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J. J. Carroll
J. CARROLL
CPT, AGC
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DEDICATION

This report is dedicated to the memory of the crew that perished in the crash of INFANT during combat operations in the Delta region of the Republic of Vietnam on 2 January 1970. Their devotion to duty was instrumental in the successful accomplishment of the combat evaluation of the forerunner of night attack helicopters - INFANT. The U.S. Army is indebted to these individuals for the professionalism which they displayed during this evaluation.

Lieutenant Colonel Roger W. Kvernes, Infantry

Lieutenant Robert L. Carmichael, Armor

Warrant Officer Dennis Debner, Aviation

Sergeant First Class Eddie L. Spivey

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ABSTRACT (U)



During the period 26 Nov 69 - 28 Feb 70, the Army Concept Team in Vietnam evaluated the Iroquois Night Fighter and Night Tracker (INFANT) to determine its combat suitability for stability operations in RVN. The weapons system, which consists of three major subsystems -- the Image Intensifier System, Night Vision (AN/ASQ-132), the UH-1M utility helicopter, and the M21 armament Subsystem --, was evaluated as a whole. However, emphasis was directed toward the image intensifier system. The general purpose of the evaluation was to assess the military worth of INFANT; specific objectives were to determine the following: system capabilities and limitations, maintainability and reliability, human factors implications, employment methods, impact upon the five functions of land warfare, countermeasures taken against the system, and the effectiveness of US Navy Formation Lights when used on night attack helicopters.

The evaluation concluded that INFANT provided an increased nighttime operational capability in the attack/surveillance helicopter role. It also concluded that the reliability and maintainability of the system were acceptable, but that improvement was needed in quality control of spare components, and that correction of deficiencies found in recurring parts failures should result in an improved MTBF and MTTR for the system. Many human factors shortcomings were identified which could be attributed to poor system engineering practices and failure to consider the man-machine interface and the mission profile of the system. The use of night formation lights on gunships resulted in identification of requirements differing from those of utility helicopters. It was noted that many findings in this evaluation appear to have applicability to similar systems under development.

It was recommended that no further procurement of INFANT systems be undertaken, and that new development of night attack and surveillance helicopters be deferred until planned evaluation of existing equipments of this type are completed and the results synthesized; that the existing INFANT

elements be organized into a provisional aviation company (armed night surveillance) and one provisional aviation platoon (night armed surveillance) -- the experience gained with this company to provide the basis for further doctrine, concepts, and techniques; that hardware improvements such as real-time integrated flight displays, improved night formation lights, and a self-contained navigator be incorporated; that target designation systems be used with surveillance and night attack helicopter systems; and that the intelligence interface with other sensor systems be examined and improved.

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SECTION I - INTRODUCTION

1. (U) REFERENCES

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- k. Final Report, Evaluation of the Night Hawk System, ACTIV Project 2/70I, Army Concept Team in Vietnam, January 1970.
- l. H-1 Airframe Change No. 15, Department of the Navy, Naval Air Systems Command, AIR 4106, 11 August 1967, subject: Formation Lights (540 Rotor System Only), Installation of.

m. Letter (C), AMSTE-BG, HQ USATECOM, 3 December 1969,
subject: Report of Predeployment Phase of the Engineering and Service
Test of Iroquois Night Fighter and Night Tracker (INFANT), USATECOM
Project Nos. 4-WE-807-INF-001/002 (U).

2. (U) PURPOSE

The primary purpose of this study was to conduct a combat evaluation to determine the military worth of the Iroquois Night Fighter and Night Tracker as an integrated system consisting of a UH-1M helicopter, the Image Intensifier System, Night Vision, AN/ASQ-132, and a M21 armament subsystem. A supplementary evaluation was also conducted to determine the suitability of the US Navy Formation Lights (540 Rotor System Only) when used on an armed helicopter.

3. (U) OBJECTIVES

a. Objective 1 - To determine the capability of the INFANT system to detect and engage targets under combat conditions in RVN.

b. Objective 2 - To determine the reliability and maintainability of the INFANT system under operational and environmental conditions in RVN.

c. Objective 3 - To evaluate the human factors engineering involved in the operation and maintenance of the INFANT system and to evaluate the training of operators and maintenance personnel.

d. Objective 4 - To describe and analyze the employment of the INFANT system in combat operations in RVN.

e. Objective 5 - To determine the effectiveness of the Navy Formation Lights when used on the INFANT.

f. Objective 6 - To determine the combat intelligence collection capability of the INFANT in RVN.

g. Objective 7 - To determine the impact on firepower resulting from the use of the INFANT.

h. Objective 8 - To determine the tactical and logistical impacts of the INFANT on unit mobility.

i. Objective 9 - To determine the countermeasures, if any, used by the enemy to counteract the use of the INFANT and the effect of these countermeasures.

j. Objective 10 - To make recommendations concerning the optimum Basis of Issue (BOI) of INFANT.

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4. (C) BACKGROUND

a. Development of the Iroquois Night Fighter and Night Tracker (INFANT) was initiated to meet the requirements described in ENSURE 100S. In the 1st quarter of FY 1967, DA directed initiation of a program to develop a helicopter-mounted LLLTV capable of night vision and enabling target acquisition and fire control of a self-contained weapons system. A multiple incentive contract was awarded in the 4th quarter of FY 1967 to Hughes Aircraft Company, Culver City, California after a competitive evaluation involving several other contractors. This system acquired the name INFANT (Iroquois Night Fighter and Night Tracker) as a result of its early development title. The name INFANT denotes the whole system - helicopter, guns, and night sensor device.

b. In an attempt to reduce the development time required to field a LLLTV system, a second program for a helicopter-mounted LLLTV (ENSURE 100.1) was directed by DA in the 2d quarter FY 1968. This second system, designated as an interim Airborne Night Television System (ANTS), was designed to have significantly less capability than the AN/ASQ-132 system. Development under both programs (ENSURE 100 and 100.1) continued in parallel until December 1968. Program reviews of the AN/ASQ-132 and ANTS systems held 12-17 December 1968 revealed that contracting delays and other factors had retarded availability of the interim ANTS system and that, as a result, deployment of initial quantities of both systems would occur simultaneously. Consequently, DA terminated the interim ANTS LLLTV program in favor of expanded procurement of the AN/ASQ-132 system.

c. The UH-1C helicopter, equipped with an M21 armament subsystem, was chosen as the basic vehicle for the AN/ASQ-132 due to production availability. Significant modifications were made to the wiring, instrumentation, and control panels of the UH-1C, in addition to strengthening the nose M5 grenade launcher hard-points to accept the AN/ASQ-132 periscope assembly installation. The T53-L-13 engine was installed in the UH-1C, resulting in the new designation of UH-1M.

d. A New Equipment Training Team (NETT) consisting of six aviators, one MCOIC, three utility helicopter crew chiefs, two aircraft armament repairmen, three television equipment repairmen, one special electronics equipment repairman, one signal parts specialist, and two contractor field service representatives introduced the AN/ASQ-132 system into RVN. The NETT personnel participated in CONUS predeployment testing and attended contractor factory training prior to deployment. During the conduct of the ACTIV evaluation, personnel of the NETT participated as evaluators and data collectors.

e. The first three AN/ASQ-132 systems arrived in RVN 2-6 November 1969. Processing was accomplished without difficulty at the 520th Aircraft Processing Detachment, Tan Son Nhut Air Base. Following this, the INFANT helicopters were flown to Sanford Army Airfield, Long

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Binh, where NETT personnel installed two of the three AN/ASQ-132 subsystems. Work was completed in six days, including boresighting and system checkout. On 16-17 November 1969 the INFANT NETT and equipment moved to the evaluation site at Lai Khe, taking up quarters with D Co, 227th Avn Bn. Transition training of 1st Cavalry Division aviators commenced on 17 November 1969 using one UH-1M without the AN/ASQ-132 installed. INFANT system training of new operators commenced the following day using the two installed subsystems. Sufficient training was accomplished by 26 November 1969 to undertake operational missions in the 1st Cavalry Division Tactical Area of Responsibility (TAOR).

f. During CONUS predeployment testing, it was found necessary to develop a special 7.62mm tracer ammunition. Conventional tracer was too bright for use with the image intensifier tubes in the AN/ASQ-132 since it caused permanent burns on the tubes. A covert Dim Tracer, XM276, was developed for use with image intensifier devices. One million rounds of this special ammunition, linking nine standard ball ammunition to one dim tracer, were provided for use during the combat evaluation.

g. Muzzle flash from the miniguns was found to cause pilot distraction during CONUS testing. To correct this situation a flash suppressor under development for the M134 minigun was also furnished for use with the INFANT system. Although it was a prototype suppressor, USAFECOM furnished a sufficient quantity to outfit all INFANT miniguns. Development of the flash suppressor, coinciding with INFANT deployment, provided an additional covert feature.

h. Three ENSURE 105S Night Flying Control Systems were programmed for installation on INFANT helicopters. However, it was found that the design characteristics of the 105 lighting system were not compatible with the UH-1M 540 rotor system. Consequently, three sets of US Navy formation lights designed for the UH-1E (Navy version of UH-1M) helicopter were obtained by the Project Manager, SEA NITEOPS for use with INFANT. The characteristics of the Navy lighting system are similar to the ENSURE 105 system, which was designed for use with the UH-1D/H rotor system. At the time of deployment only one of three INFANT helicopters had the formation lights installed. Subsequently a second aircraft was also equipped with the lights. The third helicopter did not have a formation light system installed prior to completion of the evaluation because the equipment did not arrive as scheduled.

i. The INFANT system was procured in three phases under the management of the USAMC Project Manager, SEA NITEOPS. Phase I consists of four R&D developmental systems. Phase II, also an R&D procurement of six systems, incorporates several engineering changes resulting from early demonstrations and tests conducted in CONUS. Phase III INFANT procurement consists of 26 systems and three bench test kits procured under a limited production (LP) type classification. Phase

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II and Phase III are of the same configuration, incorporating mainly human factors and technical improvements over the earlier Phase I prototype. The ACTIV evaluation is based upon results obtained using three Phase I systems.

j. On 2 January 1970, while performing a night armed reconnaissance mission in the IV Corps Tactical Zone, RVN, INFANT System 1 (UH-1M, 66-0726) crashed and burned. At the time of the crash the helicopter was engaging an enemy target with rocket fire. The system was totally destroyed and the crew perished in the crash. Investigation could not determine the specific cause of the crash, but did reveal three possible causes: enemy action, target fixation, or materiel failure. On 24 January 1970, a replacement aircraft (66-0584), less AN/ASQ-132 components, arrived at USARV. To make up a complete INFANT system, spare AN/ASQ-132 components on hand in RVN were installed by NETT personnel.

5. (C) SCOPE

a. Three Phase I INFANT systems were assigned to the 1st Cavalry Division (Airmobile) and evaluated during combat operations in the western half of the III Corps Tactical Zone (CTZ) and IV CTZ. Generally, the systems were employed in direct support of brigade operations in any manner the commander deemed appropriate to assist in the accomplishment of the 1st Cavalry Division (AM) assigned mission. In addition, INFANT systems were placed under operational control (OPCON) of the 1st Infantry Division, 25th Infantry Division, and 1st Aviation Brigade (supporting the Delta Military Assistance Command) at various times during the evaluation. This was done in an effort to broaden the evaluation base by varying terrain characteristics and providing exposure to tactics and techniques employed by other organizations.

b. A complete evaluation, encompassing all environmental conditions and operating situations, was not possible due to the limited number of AN/ASQ-132 systems and to the abbreviated (3-month) data collection period. Additionally, this evaluation was limited to those features found within the III & IV CTZ. The AN/ASQ-132 system was not used to detect and recognize targets in varying terrain features found in other areas of RVN.

c. Additional data pertaining to INFANT fire team operations were obtained during night missions to permit an assessment of the US Navy Formation Light System. This survey was limited to the subjective opinion of the pilots and co-pilots flying night operational missions as part of a fire team equipped with the Formation Light devices.

d. Missions were not scheduled solely for the purpose of providing data for the evaluation. This factor did not prevent attainment of the evaluation objectives.

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6. (U) MATERIEL DESCRIPTION

The INFANT system (Figure 1-1) consists of three major subsystems: a standard UH-1M utility helicopter equipped with the M21 Armament Subsystem and the Image Intensifier System, Night Vision, AN/ASQ-132. INFANT is used to describe the entire weapon system, while AN/ASQ-132 applies only to those components which provide the night target acquisition and fire control capability. This description will cover the basic AN/ASQ-132 subsystem and its interface with the helicopter and armament subsystem. For a more detailed description of the AN/ASQ-132 see Appendix A.

a. General

(1) The AN/ASQ-132 subsystem consists of a direct-view image intensifier sensor and display, a low-light level TV (LLLTV) sensor and three displays, and two infrared searchlights.

(2) The subsystem's two night-vision sensors are mounted on the nose of the UH-1M helicopter in an integrated turret assembly (periscope) which attaches to the existing reinforced external M5 grenade launcher hardpoints. The sensor in the turret on the right side of the helicopter is an image intensifier combination called the direct-view subsystem. This subsystem is used by the copilot/gunner for surveillance and fire control. The sensor in the turret on the left side is a low-light level TV camera called the remote view subsystem. This subsystem is used for navigation, surveillance, and fire control by either the pilot or the copilot/gunner. When not in use, the sensors are rotated to a stowed position.

(3) The LLLTV picture presented by the remote view subsystem is displayed to the pilot on an 8-inch video monitor to the right of his instrument panel (Figure 1-2), and to the copilot to the left of his instrument panel (Figure 1-3). A 14-inch video monitor in the rear cabin enables an observer to assist in detecting and recognizing targets (Figure 1-4). The space below the monitor is occupied by the data processing electronics for the AN/ASQ-132 subsystem. A hand control located on the helicopter pedestal is used for pointing the remote-view TV sensor which may be turned $\pm 70^\circ$ in traverse and $+15$ to -80° in elevation (Figure 1-5).

(4) The display for the direct-view image intensifier subsystem is a monocular eyepiece attached to a 9-foot fiber optic bundle (Figure 1-6). When not in use, this display is stowed on the doorframe to the left of the copilot/gunner. When used, the eyepiece is attached to the M6 Sighting Station. This subsystem is separately energized. The sighting of the direct view subsystem may be operated independently of the remote view subsystem or, if desired, both sensors can be slaved together to follow the commands from the M6 sight.

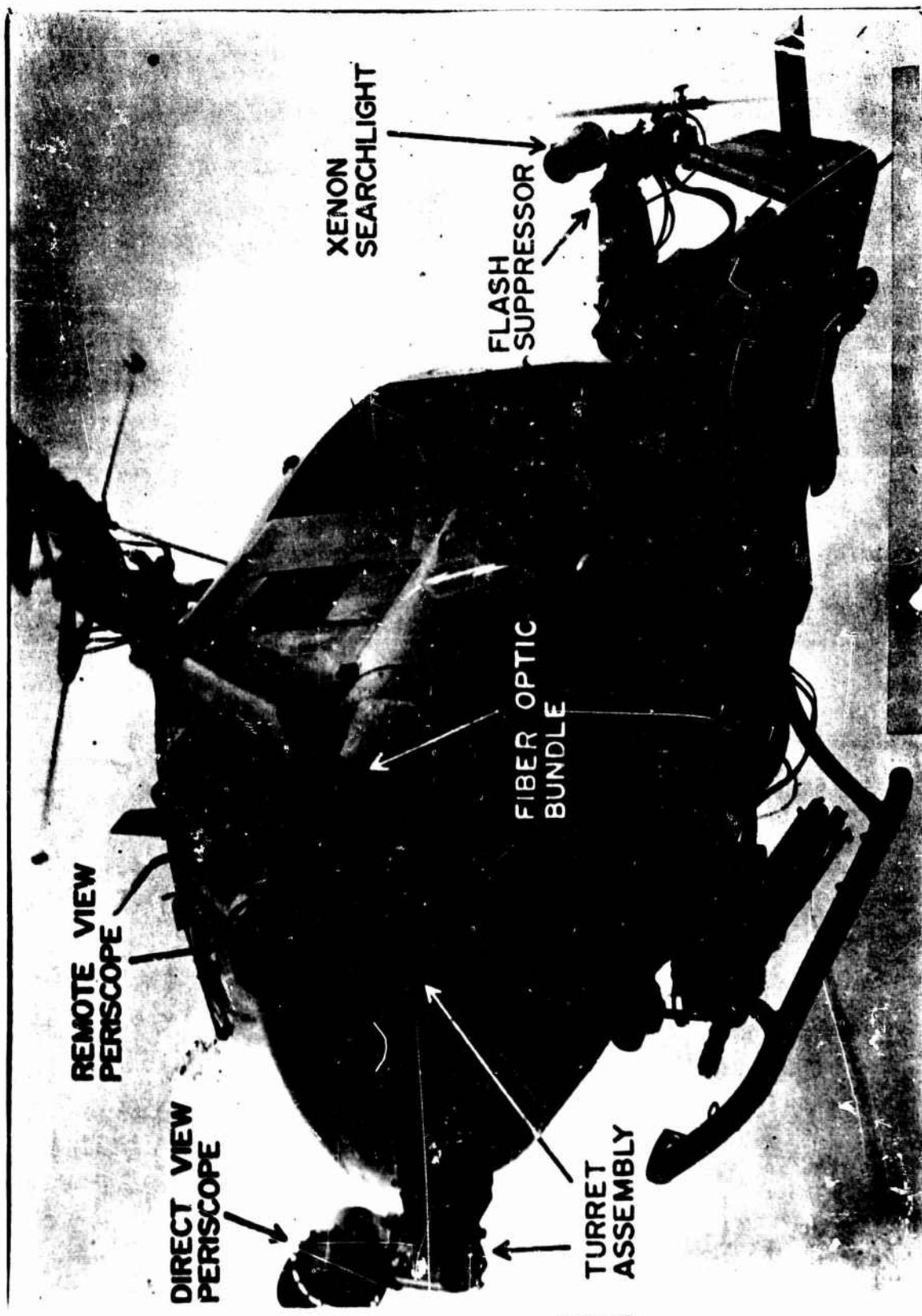


FIGURE 1-1. Iroquois Night Fighter and Night Tracker (INFANT)

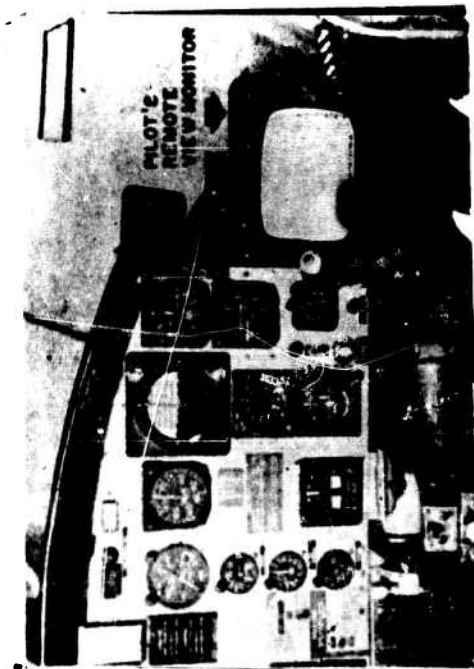


FIGURE 1-2. Pilot's Remote View Monitor



FIGURE 1-3. Copilot/Gunner's Remote View Monitor



FIGURE 1-4. Observer's Remote View Monitor and Data Processing Electronics



FIGURE 1-5. Hand Control and Control Panel

(5) Two 500-watt infrared searchlights are used to augment covertly the natural illumination when required. The searchlights use xenon lamps and are equipped with filters that eliminate all visible light outside a 10° beamspread, and further than 500 feet from the lamp. The lights are mounted on the interior gimbal of the gun mounts (Figure 1-1) in such a manner that they are boresighted with the miniguns.

(6) The control panel for the AN/ASQ-132 is located on the helicopter pedestal between the pilot and copilot (Figure 1-5). It contains the on-off switches and various mode and adjustment controls required for system operation.



FIGURE 1-6. Copilot/Gunner's Eyepiece and Fiber Optic Bundle

(7) The M21 consists of two miniguns on flexible mounts, one on each side of the helicopter, and removable rocket pods that can be attached below each minigun. The guns of the M21 Armament Subsystem may slave directly to the AN/ASQ-132 system sensors or they may be operated separately. To aim rockets the remote view subsystem is automatically aligned with the fixed boresight line of the rocket tubes. The rockets are then aimed by pointing the helicopter at the target, making use of the crosshair display on the remote view monitor.

b. Viewer Test Kit (Figure 1-7)

A major component of ground support equipment provided as special test equipment is the viewer test kit for the AN/ASQ-132. The kit is furnished in its own rugged carrying and storage chest. The viewer test kit housing is a two piece tube. The two pieces of the tube telescope to provide changes of focus (apparent range to target). It stands on three adjustable legs and attaches to the remote or direct view periscope windows by means of an adapter that provides a light-proof fit for the test kit. The optical equipment inside the kit consists of a lamp, spectral band pass filter, adjustable attenuating filter wheel, light diffuser, target chart (Figure 1-8) and a three-element objective (collimating) lens. A voltage-regulating circuit is provided to power the lamp. Power is supplied from the helicopter battery. The tests

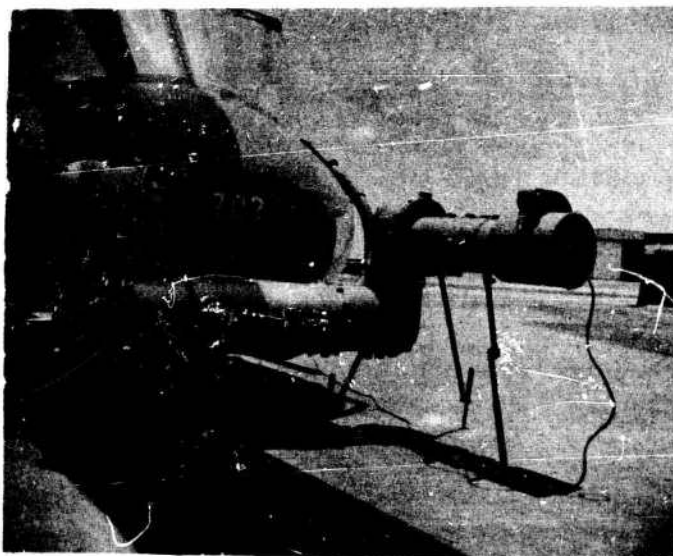


FIGURE 1-7. Viewer Test Kit Coupled to Remote View Periscope

performed with the viewer test kit are for:

- (1) Magnification
- (2) Focus
- (3) Distortion
- (4) High Light Level Resolution
- (5) Low Light Level Resolution
- (6) Video Signal Level
- (7) Automatic Light Control Response.

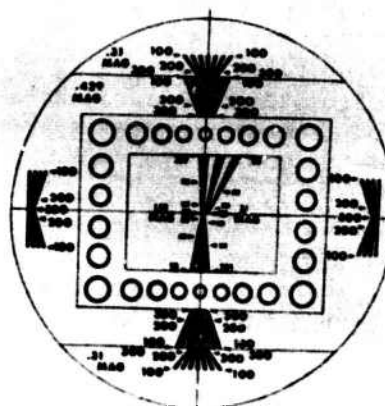


FIGURE 1-8. Viewer Test Kit Target Chart

c. Flash Suppressor

A prototype flash suppressor for the M134 automatic gun was furnished for use on the INFANT systems by the US Army Weapons Command,

Rock Island Arsenal. The suppressor is being procured under a limited production type classification. The suppressor assembly, P/N C11691135, manufactured by Mathewson Tool Company, Orange, Connecticut under DA contract DAA-F01-07-Q-1899, consists of three subassemblies: Nut, flash suppressor, P/N C11691129; Bolt, flash suppressor, P/N C11691128; and Suppressor, cluster, P/N C11691134. The suppressor cluster is an investment casting containing five protruding fingers for each barrel muzzle (see Figure 1-9). The cluster is attached to the gun by a bolt running from the center of the cluster flange down between the six barrels to the gun's barrel clamp where it is secured with the nut. The nut has a hole perpendicular to its axis which permits the barrel clamp bolt to pass through it, thereby locking it in place.

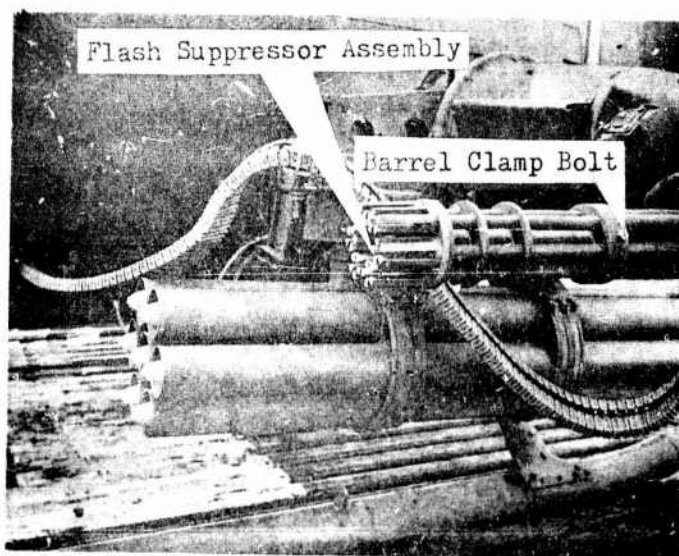


FIGURE 1-9. M134 Automatic Gun Flash Suppressor

d. Dim Tracer

A special tracer ammunition was furnished for use with the INFANT system. This ammunition was developed by the US Army Weapons Command, Frankford Arsenal in order to prevent permanent burns on image intensifier tubes caused by conventional tracer rounds. The dim tracer is conventional 7.62mm tracer ammunition modified chemically to produce a low-intensity light. It is designated as Cartridge, 7.62mm, Linked Dim Tracer, XM276 with a DODIC classification of A163. This cartridge is identified by green paint on the nose of the round.

e. Formation Lights (540 Rotor System)

INFANT aircraft were outfitted with a non-standard US Navy Formation Light Kit similar in configuration and characteristics to a system previously evaluated by ACTIV (see references 1j and 11). The formation lights consist of four electroluminescent light panels with an illuminated surface area of approximately 6 square inches (located along the upper fuselage profile); two incandescent multi-bulb, lamp fixtures (one on each outboard rotor tip); and appropriate controls (located on the cockpit ceiling) (see Figure 1-10).

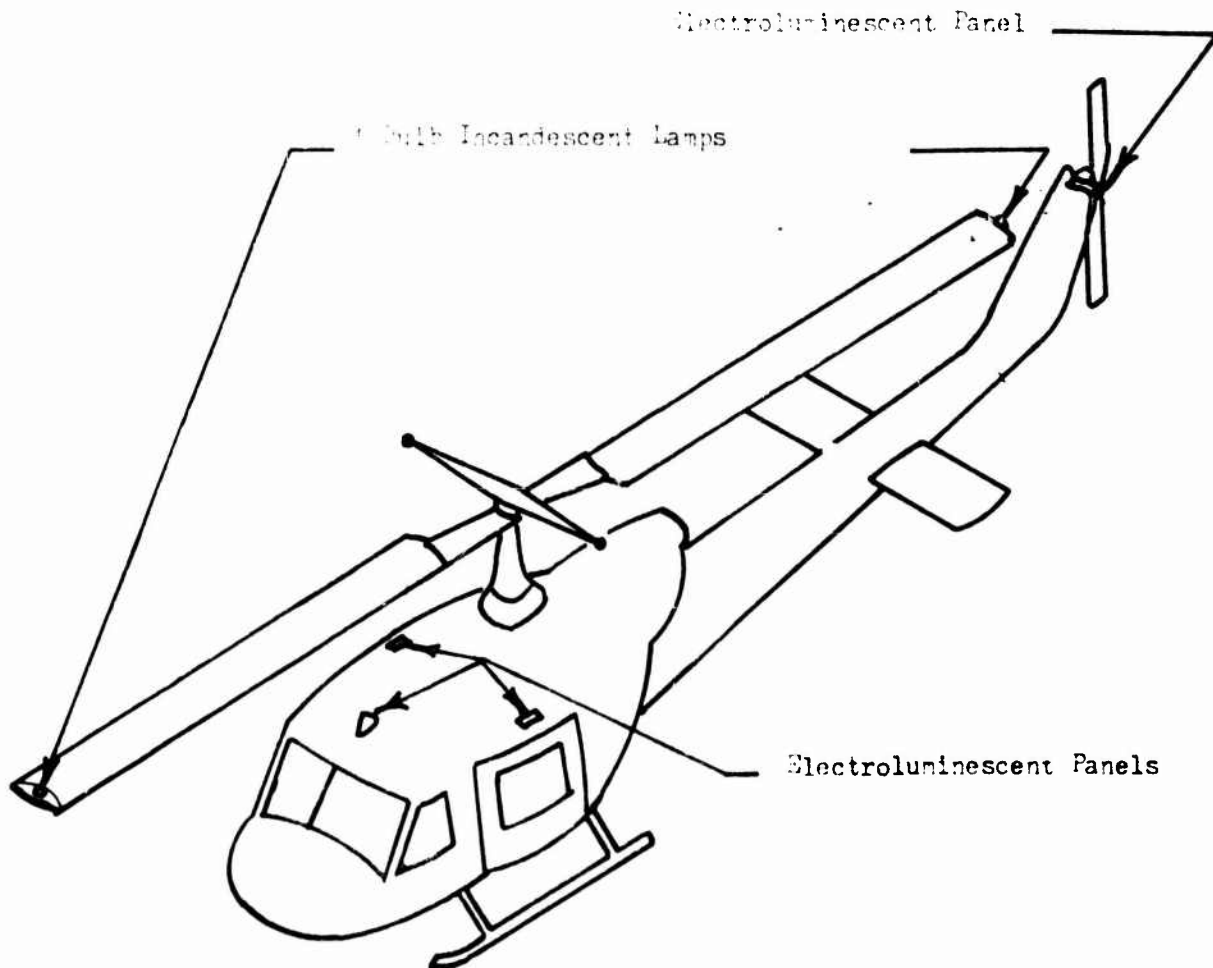


FIGURE 1-10. Location of Formation Lights

7. (U) APPROACH

a. Three categories of operational variables were investigated.

(1) System capabilities (technical and operational performance).

(2) System environment (weather and support services).

(3) System mission (primarily night armed reconnaissance).

b. Evaluation of the operational variables was conducted through analysis of the supporting measurable factors.

(1) System Capabilities

(a) Operability (control, interpretation)

(b) Compatibility (human factors engineering)

(c) System technical performance

(d) Reliability (MTBF)

(e) Maintainability (MTTR).

(2) System Environment

(a) Weather (humidity, temperature, density altitude, ground conditions)

(b) Human factors (training, experience, attitude)

(c) Maintenance and supply (support facilities)

(d) Radio communications

(e) Enemy threat (disposition, type)

(f) Time (duration).

(3) System Mission

(a) Flight envelope (speed, altitude, operational restrictions)

(b) Operational procedures (mission cycle, scenarios)

(c) Techniques of employment (formations, number of assigned missions, system availability)

(d) Utilization (flying hours).

c. The specific individual data elements were derived from the measurable factors, reduced to specific questions and documentable information, and prepared in the form of data sheets and questionnaires.

d. The data collection phase of this evaluation was directed to the documentation of all pertinent data to support analysis of the capability of the INFANT system to detect and bring fire on hostile targets. This capability was determined by the system performance in relationship to the following factors:

- (1) Techniques of employment
- (2) Reliability and maintainability
- (3) Personnel and training requirements.

Measurement of system performance also provided the data and information required as a basis upon which to make recommendations for a basis of issue.

8. (U) ENVIRONMENT

a. The INFANT NETT assigned to D Company, 227th Assault Helicopter Battalion, 1st Cavalry Division (Airmobile), conducted operations from Lai Khe airfield except for one 10-day period of operations from Can Tho airfield (1 January to 10 January 1970). The entire NETT including the AN/ASQ-132 DS/GS Maintenance Support Van was located at Lai Khe. Operations at Can Tho were conducted with a limited maintenance capability consisting of line replaceable units (LRU), TK-100, and TK-105 Electronic Tool Kits and selected test equipment and spare parts.

b. The areas of operation extended over the western half of the III Corps Tactical Zone (CTZ) and most of the IV CTZ (Figure 1-11). These CTZs encompass the Mekong Terrace and Mekong Delta regions of RVN.

(1) The Mekong Terrace is bounded on the northeast by the western slopes of the Southern Annamite Mountains, and on the southwest by an arbitrary line passing just southwest of Tay Ninh, Saigon, and Vung Tau. The terrace is generally characterized by undulating topography which grades into rolling hills near the Annamite Mountains. Throughout the terrace there are several large river valleys which are extensively planted with rice. The most notable are the Dong Ngai River and the Saigon River. The terrace region is partitioned by different vegetation types which are the main limiting factors to movement of men and vehicles through this geomorphic province. The southern portions of the Mekong Terrace are generally composed of rice paddy lands. The most northern portions of the area are characterized

by thick broadleaf evergreen forests. The northeastern portions of the area are covered by secondary forests, and near the western slope of the Southern Annamite Mountains multicanopied forests are dominant.

(2) The Mekong Delta begins southwest of Saigon and continues southwesterly to the Gulf of Siam. It is a flat feature which is inundated during most of the year. The average elevation of the delta does not vary over a meter for tens of miles. The majority of the land in the Mekong Delta was or is under cultivation and the major crop is rice. Two exceptional areas are the U-Minh Forest and the Plain of Reeds. The U-Minh Forest is an almost impenetrable swamp of mangrove and similar types of vegetation. The Plain of Reeds is a perennially wet marsh area which is inundated 1 to 5 feet during the wet season.

c. The weather conditions were characterized by occasional monsoon showers and low clouds during the first half of the evaluation period. Good flying weather with generally unlimited cloud ceilings and fair to moderate visibilities prevailed during the latter half. Dusty haze was the most significant factor related to visibility limitations. Temperature averaged 23 degrees C (73 degrees F) during night operations.

d. Because of the combat environment of RVN, control over the test conditions was not possible. Therefore, a survey type evaluation was conducted with data collected during all missions flown using the INFANT system. Data was examined comprehensively to identify the significant, relevant characteristics of the environment encountered; to identify those characteristics not encountered; and to avoid biased conclusions as a result of general statements that may ignore the constraints.

SECTION II

OBJECTIVE 1 - CAPABILITIES

9. (U) GENERAL

The INFANT system consists of three major subsystems: UH-1M, utility helicopter; Image Intensifier System, Night Vision, AN/ASQ-132; and the M21 Armament Subsystem. The AN/ASQ-132 is further broken down into three functional subsystems as described in Appendix A. The three major subsystems are integrated to provide a weapon system (INFANT) capable of target acquisition and fire control under low light level (night) conditions. Immediate engagement of targets using the armament subsystem is possible, when other tactical conditions permit.

10. (U) SYSTEM OPERATION

a. The direct view (DV) and remote view (RV) sensors, with their associated gimbal groups, are in a dual side-by-side turret, mounted in a manner similar to the M5 Armament Subsystem. Each sensor may be operated independently or they may be slaved together. Target detection is accomplished through amplification of the ambient light level of the scene as observed in the sensors' instantaneous field of view (IFOV). The RV sensor subsystem displays target information to the pilot, copilot, and rear observer by means of cathode ray tubes (television) at each station (see Figure 2-1). The DV subsystem displays target information to the copilot/gunner by means of a fiber optic bundle and eyepiece attached to the M6 Sighting Station. The RV and DV displays provide real-time imagery of the target area. Crosshairs are incorporated into both displays to allow aiming of both the flexible and fixed weapons. Indicators (see Figure 2-1) on the RV displays provide traverse and elevation information of the RV line of sight with reference to the aircraft's longitudinal axis.

b. The sensor drive mechanisms are designed to be compatible with the traverse and elevation capability of the M21 Armament Subsystem. Aiming of the sensors toward the desired target area is accomplished through controls provided in the cockpit. The pantograph sight control (M6 Sighting Station) is used to position the DV sensor. A position-type hand control, located on the helicopter pedestal, is used to direct the RV sensor. Both controls are integrated with the M21, enabling aimed fire using the target display. The M6 Sighting Station may also be used to operate the RV and DV simultaneously, if desired.

c. Available ambient light can be supplemented, when required, by xenon searchlights mounted on the miniguns that provide covert, pink-filtered illumination. This feature permits extension of target detection and recognition ranges when operating under low (starlight) ambient light conditions. Detection and recognition of targets with the DV and RV sensor subsystems may also be enhanced optically through four



FIGURE 2-1. AN/ASQ-132 Display and Imagery

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selectable magnifications.

d. Because of the inherent sensitivity of image intensifiers to bright light, a special dim tracer, XM276, was developed. This tracer is not visible to the naked eye but is easily seen with the AN/ASQ-132 (see Figure 2-2). Although INFANT cannot be considered a completely covert system due to the noise level of the helicopter, the dim tracers enhance covert characteristics, since the enemy cannot follow the tracer path to its source. Additionally, the flash suppressor for the miniguns was very effective in eliminating the normal muzzle flash.

11. (C) PERFORMANCE FACTORS

a. Ambient Light

Lighting conditions prevailing during the various phases of the moon have a noticeable effect on the quality of the sensor display. A full moon provides the best display. Under starlight conditions, quality is reduced but targets remain detectable.-- especially under favorable contrast conditions (see below). With the aid of the searchlights, targets could be readily detected under low ambient light conditions. However, this restricted use of the sensors to the two highest magnifications, which had the smallest fields of view, since they are compatible with the 10-degree fixed beam width of the searchlights.

b. Target to Background Contrast

The detectability of a target under nighttime conditions using the AN/ASQ-132 is largely dependent upon the degree of contrast between the target and its background, much the same as during daylight visual reconnaissance. In general, high ambient light levels (full moon) make the contrast between objects more evident, while the lower light levels (starlight) provide a display that appears washed-out and lacks sharpness. Shadows, movement, incongruity, and light sources were the primary contributors to detection. The majority of the detections made were attributable to incongruity.

c. Variable Field of View (VFOV)

As a result of being able to use four discrete fields of view, surveillance altitude could be varied. High ambient light conditions permitted the operator to search a large area in the widest FOV from an altitude of 1500 feet above ground level (AGL). A more detailed examination was possible at this altitude by use of the narrower FOV. However, under most conditions encountered, an altitude of 600-1000 feet AGL was normally required due to sensor limitations. Operators preferred the highest altitude possible under high ambient light, since targets could generally be detected at greater slant ranges making first run attacks with the armament subsystem possible. When employing the magnification feature under poor light conditions, it was found that the

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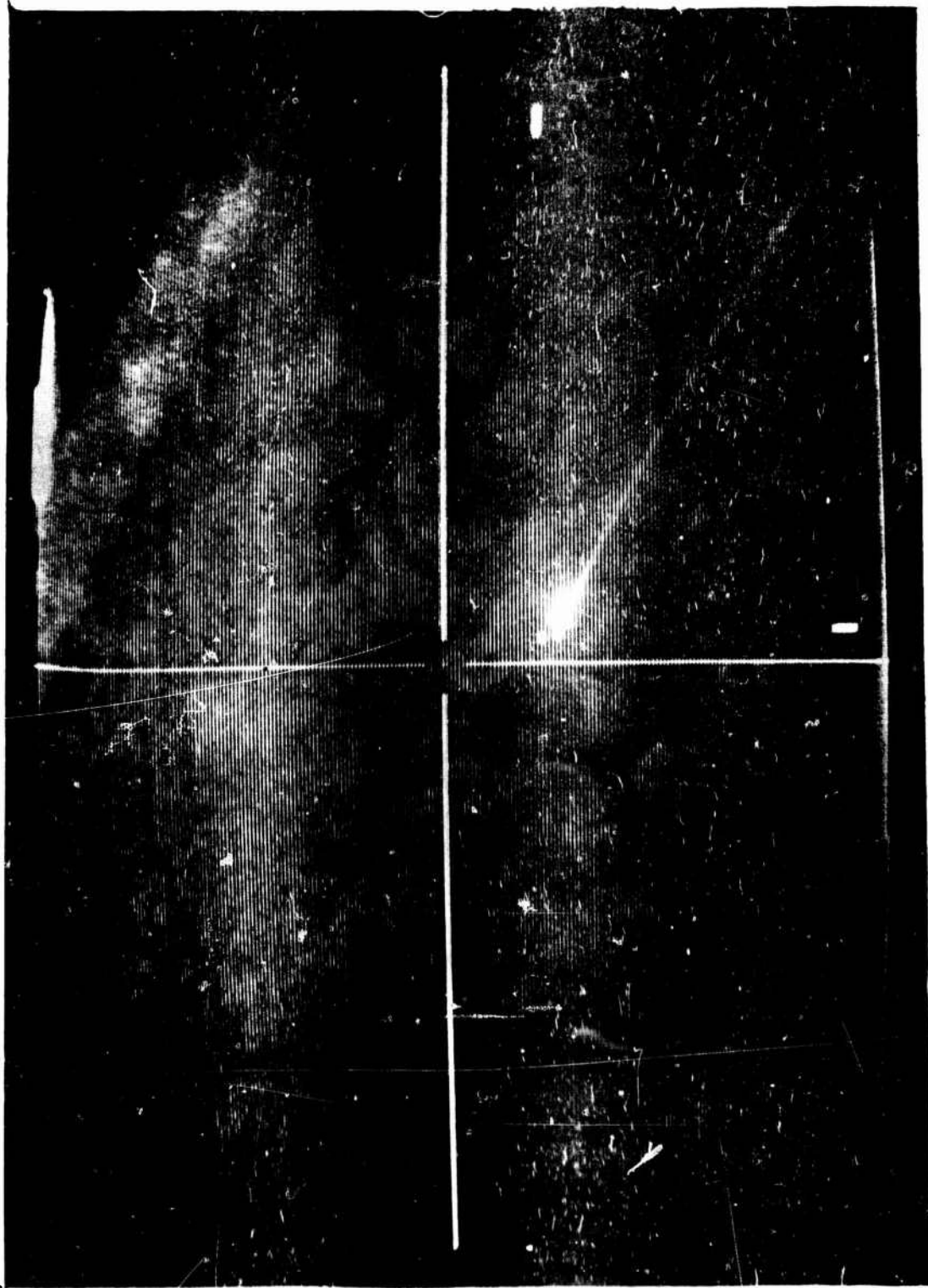


FIGURE 2-2. Remote View Display Showing Right Minigun Firing Dim Tracer

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narrower the field of view, the poorer the quality of the display. This is attributed to an inherent design characteristic which, in effect, cuts down the amount of available light as the FOV is narrowed.

d. Rules of Engagement

Under the rules of engagement in effect during the evaluation, and because of the checkerboard disposition of friendly forces on the ground, difficulty was experienced in determining whether some detections were enemy or friendly. This was particularly true because friendly troops had no need to practice concealment from the air, since there was no threat in that area. Furthermore, the restrictions imposed by the rules of engagement greatly inhibited the exploitation of targets of opportunity. These rules are stated in Annex B, MACV Directive 525-13 (see Appendix B).

e. Battle Damage Assessment (BDA)

Assessment of actual results obtained during INFANT operations was not always possible. The following factors influenced this situation:

- (1) Lack of friendly troops to conduct timely ground search
- (2) The enemy practice of removing dead and wounded
- (3) Inaccessibility of the target area
- (4) Overwhelming enemy force, preventing loiter in the target area
- (5) Natural concealment in the target area.

12. (C) DETECTIONS BY AIRCREW OBSERVATION

As a result of the evaluation, the conditions under which target detection by INFANT crews occurred were categorized. Table 2-1 contains the results. The validity of these figures is questionable, however, since many variables existed which tend to confound the data. Among these are such things as individual differences in range estimation, two-dimensional nature of the target display (non-steroscopic), target/background conditions (contrast, clutter), target concealment, individual differences in perception, target movement, and terrain. In addition, the data furnished are based upon an evaluation environment that was generally considered to be the most adverse for a device of this nature. For example, reported ground cover conditions were 17.3% open ground, 18.2% thin foliage, 37.4% dense foliage, and 27.1% mixed. Half of the open ground situations occurred during a single 10-day period of operation in the Delta region. It is inappropriate to draw performance conclusions from this data for the reasons cited above.

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TABLE 2-1 (C).

Detection Ranges Reported by INFANT Aircrews (U)

TYPE TARGET	LIGHT CONDITION	NUMBER DETECTIONS	HORIZONTAL RANGE (EST) (METERS)			AVERAGE ALTITUDE (FEET AGL)
			MAX	AVG	MIN	
Personnel	Moonlight	13	1000	800	300	700
	Starlight	4	1000	700	500	1000
Vehicles	Moonlight	4	1000	900	800	700
	Starlight	0	-	-	-	-
Sampan	Moonlight	2	1200	1100	1000	800
	Starlight	11	1000	900	500	900
Light Source	Moonlight	12	2200	800	300	700
	Starlight	14	1500	1000	300	700
Structures, Sites	Moonlight	4	1000	500	100	600
	Starlight	28*	2000	1000	600	1000

*Twenty-four of these detections occurred in the Mekong Delta, where terrain conditions were optimal. Detections occurred during no moonlight conditions while operating in this area.

The data do, however, serve to indicate approximate detection ranges experienced during the evaluation and support findings obtained during the engineering test (ET). (Reference 1a).

13. (C) RECOGNITION CAPABILITY

Operators found that the four selectable fields of view (magnification zoom effect) enhanced target recognition. Although the display quality, under moonlight conditions, degraded slightly as the operator went from wide to narrower FOV, as previously mentioned (Paragraph 11c), the apparent magnification did aid in recognition since category, shape, and size relationships were more discernible in the narrower FOV. Under starlight conditions, only the two narrowest FOVs were utilized with the searchlights, resulting in simultaneous detection and recognition.

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It was determined that altitudes between 600 and 800 feet AGL yielded the highest probability of recognition. Most targets were recognized at an estimated distance of 300 to 500 meters ahead of INFANT. Searchlights were reported to be effective only in the two narrowest FOV and at the shorter slant ranges. In general, recognition of targets was accomplished without difficulty when the object was within the same detection range and under similar prevailing conditions as those that would have resulted in detection without additional aid during daylight conditions. Recognition based upon size, shape, and relationship to surroundings was the most common technique employed.

14. (C) ENGAGEMENT CAPABILITY

a. Some ambiguity exists in the reported ranges for target detection and engagement. This is a result of the fact that, under certain conditions, positive recognition was deemed neither necessary nor appropriate if surprise was to be exploited. For example, many missions in specified strike zones (SSZ) were assigned to INFANT. Within these SSZs, freedom to engage targets was predetermined by the fact that the area was reported clear of friendly troops. Positive determination of friendly unit locations always preceded assignment of these areas, which were defined by coordinates or easily identified terrain features. Additional controls such as ground controlled approach (GCA) radar (in the surveillance mode) and a second helicopter flying higher than INFANT were employed in order to provide positive position location to the INFANT crew when operating under SSZ procedures. The second aircraft served as the GCA target, since INFANT was normally too low for radar tracking.

b. Altitudes flown during the evaluation varied from 600 to 1500 feet AGL. The higher the altitude, the more time an operator had to prepare for engagement, particularly with rockets; consequently, operators normally flew at the highest possible altitude the existing light and terrain conditions would accommodate. The average detection altitudes reported were those at which targets were engaged with mini-guns, since rockets were generally fired on a second pass from a higher altitude (1000 feet AGL). For any given target, the operators reported engagement altitude as the average of the first and subsequent passes. Table 2-2 contains results reported during target engagement.

15. (C) EFFECT OF LIGHT LEVEL ON DETECTION/ENGAGEMENT RANGE

a. Figure 2-3 illustrates the detection and engagement range, along with target type and ambient lighting conditions, based upon those engagements during the evaluation that were sufficiently documented. This shows that 9 of the 13 (69%) detections made beyond 1000 meters were under light conditions of less than half-moon.

b. The sloping lines on the chart represent constant ratios of detection range to engagement range. All sightings on or below the

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TABLE 2-2 (C).
Engagement Ranges Reported by INFANT Aircrews (U)

TYPE TARGET	LIGHT CONDITION	NUMBER OF ENGAGE- MENTS	HORIZONTAL RANGE (EST) (METERS)			AVERAGE ALTITUDE (FEET AGL)	ROUNDS EXPENDED	RESULTS	
			MAX	AVG	MIN			KBH EST/CONF	OBJ DEST EST/CONF
Personnel	Moonlight	13	1500	700	200	850	68	16,900	22/18*
	Starlight	4	500	400	300	1000	4	2,700	4/0
Vehicles	Moonlight	4	1500	1100	800	800	24	6,500	1/1
	Starlight	0	-----	-----	-----	-----	---	-----	-----
Sampans	Moonlight	2	1000	900	800	900	--	1,000	-/2
	Starlight	11	800	550	300	1000	36	4,700	4/0
Light Sources	Moonlight	12	1500	1100	500	900	11	6,050	2/0
	Starlight	13	1200	1100	300	900	44	19,250	24/25
Others	Moonlight	4	1500	700	200	800	14	4,200	-/3
	Starlight	28	800	600	300	1000	44	5,100	-/13

*Additional Personnel Were Concealed in Area of Engagement

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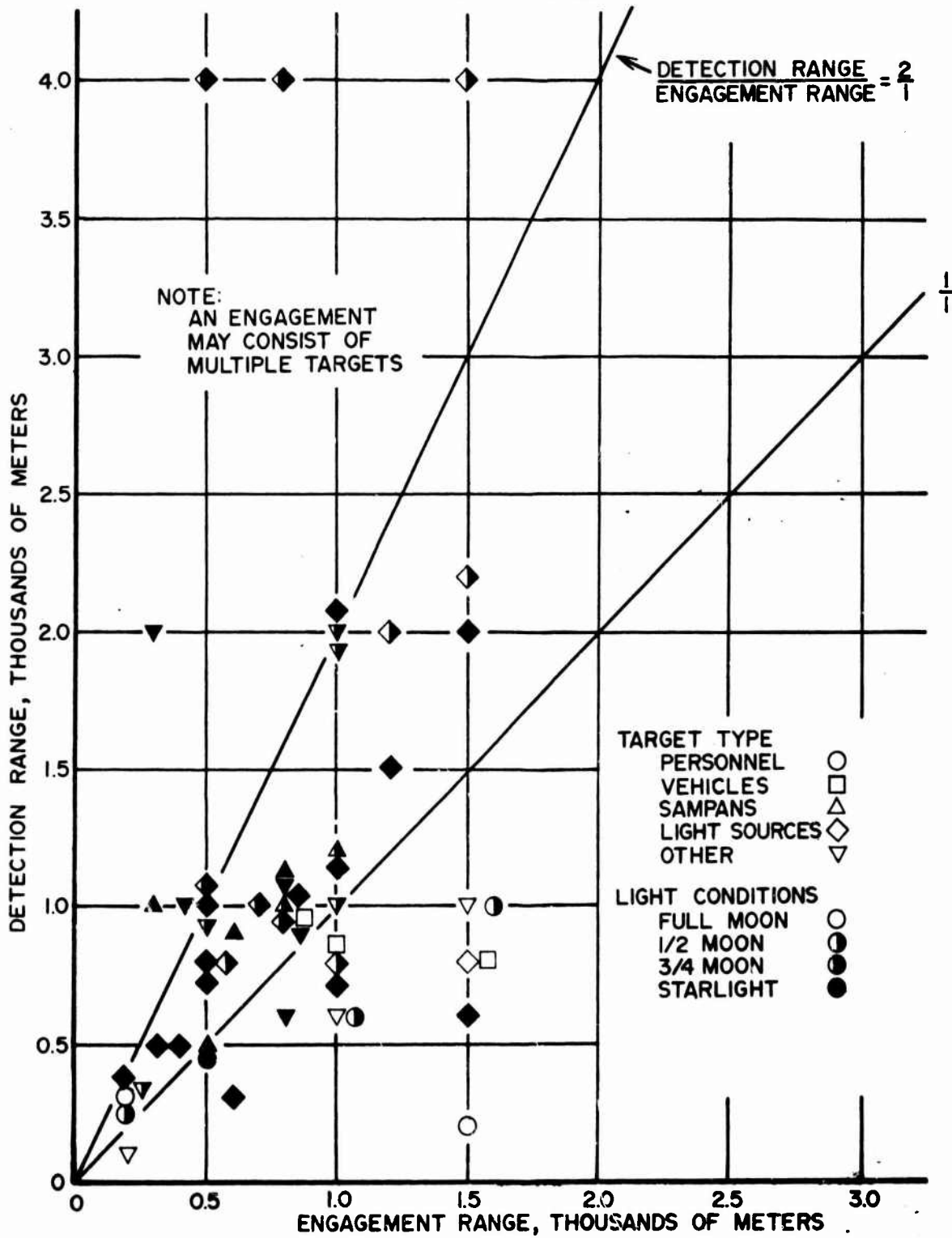


FIGURE 2-3 (C). Detection and Engagement Range for Various Target Types and Light Conditions (U)

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1:1 ratio line (32% of the total sightings) indicate that a second pass was required for engagement, since the target was engaged at a range greater than that of the initial detection. The sightings above the 1:1 line (68% of the engagements) indicate that the detection range of the system was sufficient to allow engagement on the first pass.

16. (C) TARGET DETECTION BY OTHER MEANS

During the evaluation, 16 target detections occurred without the aid of the AN/ASQ-132. On these occasions, targets were detected by another chase aircraft or by the INFANT door gunners observing ground-to-air fire or movement of personnel, usually after INFANT passed over an enemy location. In some instances the AN/ASQ-132 did contribute to subsequent engagement of a target by INFANT, while at other times a door gunner or chase aircraft engaged the target. Seven targets were engaged under moonlit conditions at ranges varying from 500 to 2000 meters. Totals of 14 rockets and 4200 rounds of 7.62mm were expended, resulting in destruction of two .51 caliber and one mortar position and 30 enemy KBH. On one occasion under moonlight conditions, a door gunner observed several enemy move from concealed positions into the open after INFANT passed over their position. They were subsequently engaged by fire successfully. Under starlit conditions, nine targets were detected without the aid of the AN/ASQ-132 and engaged at ranges between 200 and 1500 meters. Totals of 44 rockets and 5100 7.62mm rounds were expended on these targets, resulting in seven huts destroyed and six buildings and a 25-bag rice cache damaged.

17. (C) AIRCRAFT RESTRICTIONS AND LIMITATIONS

a. The UH-1M utility helicopter with the AN/ASQ-132 installed has the same operating limitations and restrictions as are normally placed on an aircraft loaded to maximum gross weight. Hence, downwind hovering was avoided during strong surface wind conditions.

b. Another problem was encountered when parking the aircraft in parallel revetment areas. The aircraft had insufficient left pedal under certain relative wind conditions (i.e., right quartering tailwind). An "L" shape revetment is recommended for best parking access (long side of revetment on right side of parked helicopter with nose facing the short base of the L).

c. A 3-foot hover is required at all times, especially during takeoffs and landings. Due to the slightly nose-low attitude of INFANT, the turret could scrape the ground while passing into effective translational lift, causing damage to the aircraft or system.

d. The aircraft should be restricted to 100 knots during straight and level flight and 120 knots in a dive. These restrictions were placed on the aircraft by USAAVSCOM under all operating conditions when the AN/ASQ-132 subsystem was mounted, as the weight and aerodynamic effect of the turret causes the aircraft to assume an unusually nose-low attitude when approaching these air speeds.

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e. As with other helicopters that operate continually at maximum gross weight, thorough periodic maintenance inspections are essential. Emphasis should be placed on inspection of the lift-link (Link Assembly, 1560-894-6535) and associated hardware. Also, the tail boom requires frequent inspection of rivets and other items for indications of fatigue.

f. Due to the restricted maneuverability of INFANT, rapid preparation for target engagement is not always possible. Tight turns at low airspeed result in excessive torque pressure requirements in order to maintain altitude. These induce accompanying structural stresses. Recovery from the dive following a rocket run is another maneuver that must be executed with care. A normal rocket run results in an airspeed of approximately 80 knots following the 8 to 15-degree dive. The nose-heavy configuration of the INFANT precludes rapid recovery. Recovery is initiated by the simultaneous addition of power and aft movement of the cyclic control lever. Recovery from descent requires approximately 2 to 3 seconds.

18. (C) FIRST STRIKE CAPABILITY

In contrast to earlier test results, INFANT demonstrated a first-strike capability with miniguns and, on occasion, with rockets, when high ambient light conditions and ideal target opportunities existed. See also Paragraph 15.

19. (U) OBSTACLE CLEARANCE, TERRAIN AVOIDANCE, AND LANDING ASSISTANCE

The AN/ASQ-132 subsystem does not furnish assistance in terrain avoidance or obstacle clearance except in gross terms. Operators reported they would not use the AN/ASQ-132 for this purpose under any circumstances. This is contrary to indications of the earlier service test. Depth perception with the night viewer is too restricted for this application. See also the previous ACTIV evaluation of another remote view image intensification system cited at Reference 1c.

SECTION III

OBJECTIVE 2 - MAINTAINABILITY AND RELIABILITY

20. (U) SYSTEM MAINTAINABILITY AND RELIABILITY (Figure 3-1)

a. General

Although maintainability and reliability are important performance parameters in a weapon system evaluation, data acquired during this ACTIV evaluation were directed primarily toward the maintainability and reliability of the AN/ASQ-132. The UH-1 helicopter and M21 armament subsystem are operational subsystems whose maintainability and reliability characteristics are well established. The maintainability and reliability determination of the AN/ASQ-132 will facilitate comparison with other night surveillance, target acquisition, and fire control systems currently under development.

b. Operational Readiness

(1) In order to draw conclusions as to the military worth of the INFANT, it was relevant to determine some of the availability characteristics of the system as a whole. A history of the operational readiness of all AN/ASQ-132 subsystems and all INFANT systems is presented in Figure 3-2. Operational readiness is defined here as the fraction:

$$\frac{\text{Number of Hours Subsystems or Systems were Operable Each Day}}{\text{Number of Hours in the Day}}$$

In the figure, when the two bars appear to coincide, the AN/ASQ-132 subsystems were the limiting factor in overall operational readiness. This occurred on 14 of 94 days (15%) of the evaluation period. This does not imply that INFANT systems were not available on the day in question, but that AN/ASQ-132 subsystems were the critical elements influencing the operational readiness of each aircraft on that particular day.

(2) INFANT aircraft were NORM (Not Operationally Ready, Maintenance) 40% of the time and NORS (Not Operationally Ready, Supply) 2% of the time. Both NORM and NORS were computed in accordance with standard procedures.

(3) Availability of INFANT for each night's mission was determined as of 1700 hours each day. The overall mission availability (all subsystems operational) was 49% for the entire evaluation period.

(4) The mission availability of the aircraft and weapons subsystems, excluding the AN/ASQ-132, was also determined. The mission availability considering only the UH-1M and M21 subsystems was 56%. The presence of the AN/ASQ-132 thus degraded mission availability by 7%. The small sample size provided during this evaluation should be kept in mind whenever any interpretation is made of these mission availability figures. Of the 94 days of the evaluation, 3 aircraft were present for 62 days, and 2 aircraft were present for 32 days.



FIGURE 3-1. INFANT Maintenance (Montage)

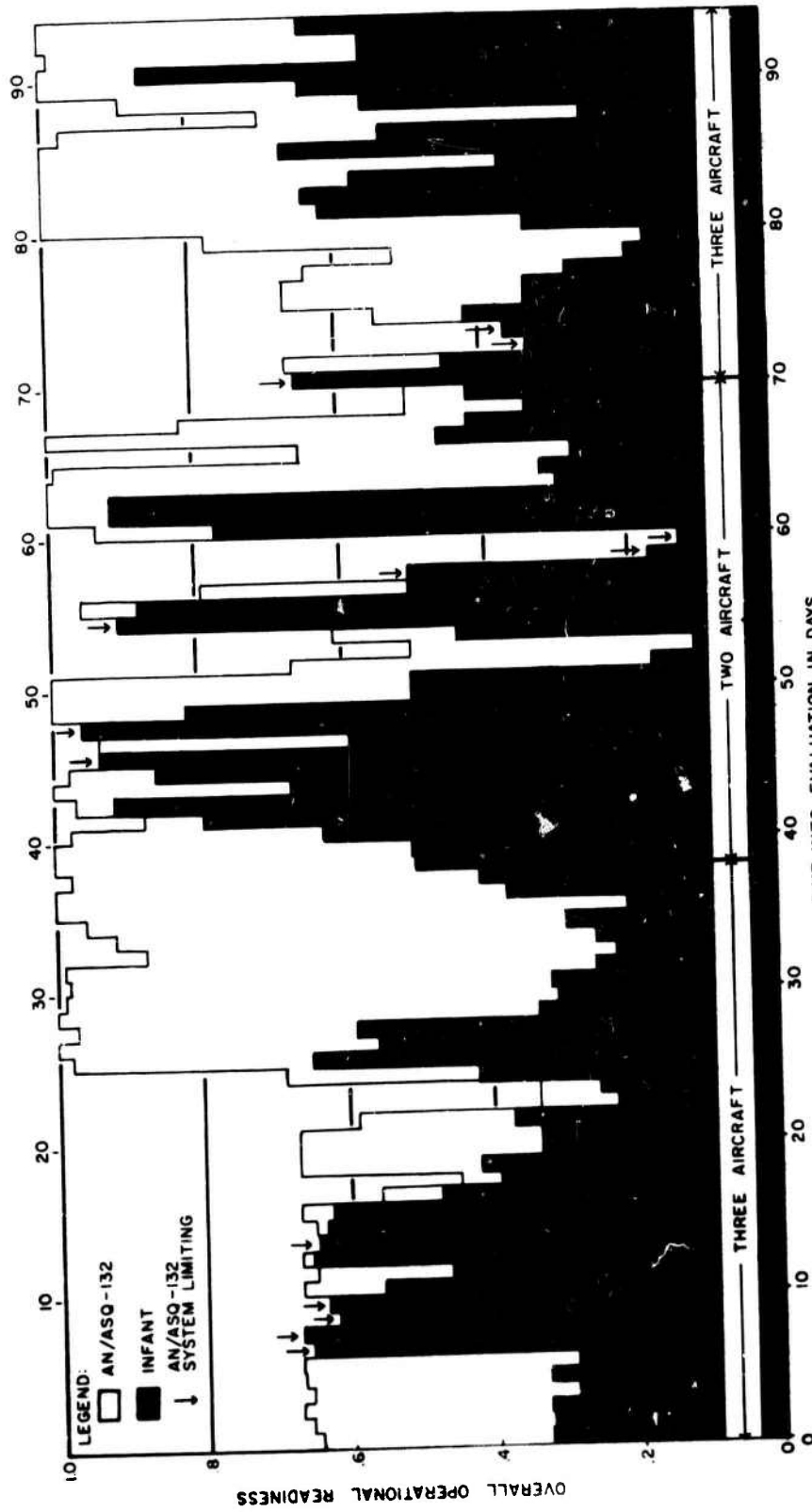


FIGURE 3-2. (U) Operational Readiness (OR)

(5) Average availability for the USARV UH-1C(A) fleet during the same period was 67%. The relatively lower UH-1M availability is attributed to the fact that the evaluation host unit was not provided additional maintenance support personnel when INFANT was attached. This amounted to a 25% maintenance workload increase for the host unit's already taxed maintenance capability and accounts for the 11% lower availability of the UH-1M when compared to the similar UH-1C(A).

21. (U) SYSTEM MAINTENANCE REQUIREMENTS

a. INFANT flew a total of 546.5 hours during the evaluation. Of this total, 217.3 hours were actual "on-station" time, during which INFANT was performing specific surveillance and target acquisition missions. The remaining 329.2 hours were consumed en route to and from areas of operation (AO) and in crew training. Four AN/ASQ-132 subsystems were operational a total of 333 hours. The overall ratio of AN/ASQ-132 maintenance man-hours to operating hours was 4:1. Distribution of the maintenance effort was found to be: organizational 28%; direct support 51%; and general support 21%.

b. Organizational maintenance of each AN/ASQ-132 subsystem averaged 2 man-hours per day. Every morning, neutral density filters were installed and INFANT underwent a complete operational check. Normal preventive maintenance was performed on the system at this time. If a deficiency was noted, immediate action was taken to correct the malfunction. Because INFANT is a night flying aircraft, a preflight of the aircraft, AN/ASQ-132, and armament subsystem was performed in the afternoon to permit corrective action, as required, during daylight. Another preflight was conducted 30 minutes prior to time of mission. During this preflight, the neutral density filters were removed and stray light visors attached to the rim of the two periscope assemblies. The windows of the periscope assemblies, the monitor screens, and the searchlight lenses then received a last minute cleaning. When the aircraft was run up for its mission, the crew made a final check of the INFANT system.

c. The following PM was accomplished on an "as required" basis:

(1) The periscope was purged with nitrogen whenever the head was opened.

(2) The vertical and horizontal alignment of the pilot TV display were checked.

(3) During helicopter periodic inspections (PE), the periscope assembly, rack mount, and electronics stabilization control amplifier were removed. Removal, reinstallation, and boreighting required 20.8 man-hours. This action was performed six times during the evaluation.

(4) When there was a requirement to sling-load the INFANT aircraft, the AN/ASQ-132 was removed as a precautionary and weight-

reducing measure when tactically feasible. The average time required for removal and reinstallation was 10 man-hours. Boresighting was required following the reinstallation, adding another 11.8 man-hours to the operation.

d. The AN/ASQ-132 system was not affected by the level of maintenance that had to be performed during the evaluation, since organizational through general support capabilities were collocated at the operational site. Maintenance personnel had the flexibility to respond to all required levels of maintenance except depot. There was no significant effect on maintenance due to nonavailability of utilities (i.e., electric power), hostile action, or nonavailability of maintenance personnel.

22. (U) MAINTENANCE TEST PACKAGE

a. The NET Team was supplied with an Electronic Shop Van, AN/ASM-199, as a maintenance facility. The van had integral heating and air-conditioning to maintain a controlled temperature for calibrated test equipment. The van has five work bench areas, each supplied with a variety of AC and DC power outputs. An external power outlet supplied 28 volts direct current (VDC) to INFANT when it was parked adjacent to the van for maintenance. An aircraft auxiliary power unit (APU) cable (not a normal component of the van) was procured separately for this purpose. Some special test equipment was supplied to enable direct and general support maintenance of components. See Appendix C for this equipment list.

b. The Viewer Test Kit (see Figures 1-7, & 1-8) was necessary for direct support maintenance of the AN/ASQ-132 subsystem. This kit is used to check AN/ASQ-132 performance throughout high to low light levels varying from 1 foot-lambert to 1 millionth of a foot-lambert. During periodic maintenance checks, which were conducted every 30 days, the Viewer Test Kit was used to check the resolution performance of the DV and RV subsystems. Whenever loss of resolution or distortion was noted, the viewers were compared, with the image of the Viewer Test Kit used as a reference. The test kit was also used in the electronic alignment of either the RV or DV subsystem. Figure 1-7 shows the test kit being used with the RV subsystem. Since this kit is highly portable, technicians were able to use it in the Electronic Shop Van or out on the flight line. When a DV subsystem camera was changed in the van, the Viewer Test Kit was utilized to check for proper shimming and performance prior to further installation.

c. Some special test adapter boxes were field-fabricated by maintenance personnel and field service representatives to aid in troubleshooting and reduce overall repair time. See Appendix D for descriptions of these items.

d. The tow bar that was initially furnished the NETT was a modified version of the standard Army tow bar. Although this bar served the purpose, it had several shortcomings. The bar was curved to fit

around the AN/ASQ-132 turret assembly (see Figure 3-3a) to eliminate the possibility of the bar striking the AN/ASQ-132 equipment. This increased the interior angle at the apex of the tow bar (see Figure 3-3b), and had the effect of reducing the normally available turning radius because of the likelihood of damage to the tow bar and towing vehicle when tight turns were attempted. A narrower apex in the vicinity of the towing vehicle is required. The capability of folding the tow bar should be retained, nevertheless, so that overall dimensions can be reduced for shipment and storage. A special tow bar designed for ground handling of INFANT aircraft was received from the contractor during the evaluation. This tow bar was found to be unsatisfactory. Its multiple-pivot design (see Figure 3-4a) did not permit the towing vehicle to steer the helicopter while towing. An attempt to turn the helicopter while towing could result in the vehicle pulling in a direction at right angles to the axis of the aircraft. In addition, the tow bar could strike the nose-mounted turrets when used in a normal manner on uneven ground (see Figure 3-4b). The unsatisfactory contractor-designed tow bar was retrograded to CONUS.

e. Overall, the maintenance test package was judged by evaluators to be adequate for direct and general support maintenance of 10 to 20 AN/ASQ-132 subsystems. However, further verification is deemed appropriate when operational quantities of INFANT become available.

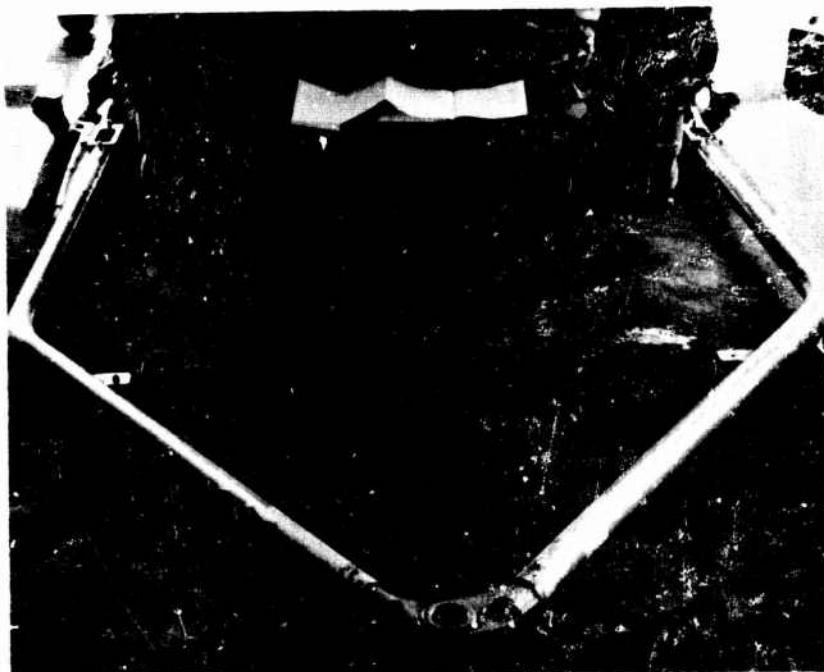
23. (U) MEAN-TIME-TO-REPAIR

a. The mean-time-to-repair (MTTR) was the first subsystem figure of merit calculated. The mean-time-to-repair is defined as the ratio of the total repair time required during a period to the total number of failures encountered during that same period. A failure is defined as a breakdown or malfunction in the AN/ASQ-132 that resulted in any functional capability of the subsystem being denied use until repair or part replacement was performed. During the evaluation period, 757.8 maintenance man-hours were necessary to repair 54 failures, yielding an MTTR of 11.6 hours. The time profile of this parameter is shown in Figure 3-5. Each point on the curve represents MTTR calculated by considering the total number of maintenance hours and failures from the beginning of the evaluation until the point in time under consideration.

b. The shape of the curve is influenced by the following:

(1) Maintenance and repairs were performed by a NETT possessing experience and skill not likely to be found in a typical population sample. The team's proficiency was further enhanced by the presence of two field service representatives (contractor personnel) who were available during the entire evaluation.

(2) Several of the maintenance requirements were found to be excessively time-consuming as a consequence of inaccessibility, number of work steps required, or number of personnel required. Further discussion of this subject is presented in Paragraph 24.

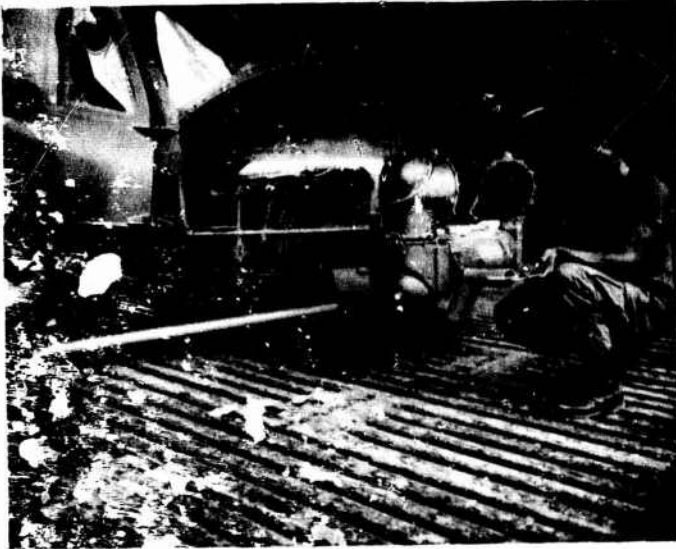


a. Rigid Tow Bar shown as it fits around INFANT Periscope Assembly

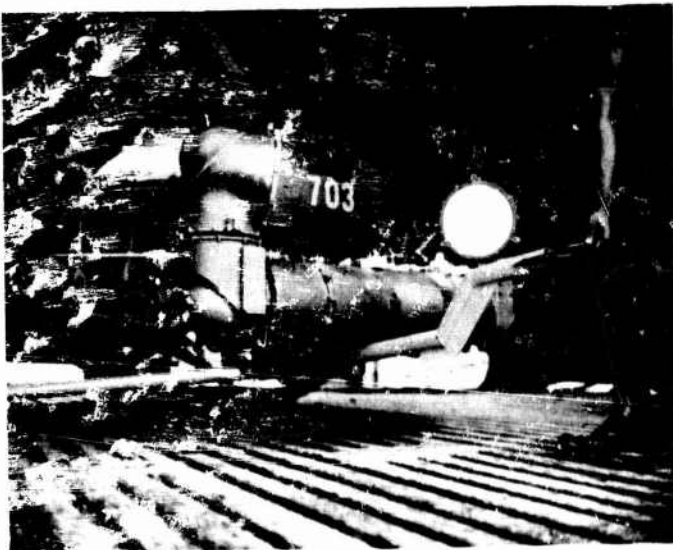


b. Widened Apex of Modified Tow Bar showing limited clearance between towing vehicle and bar

FIGURE 3-3. Standard Army Tow Bar (Modified for INFANT)



- a. Position of the tow bar when towing vehicle is executing a turn is illustrated above. The pivot point beneath the avionics compartment flexes without causing the helicopter to turn.



- b. The position of the tow bar when towing vehicle is on ground slightly higher than the helicopter.

FIGURE 3-4. Contractor-Developed INFANT Tow Bar

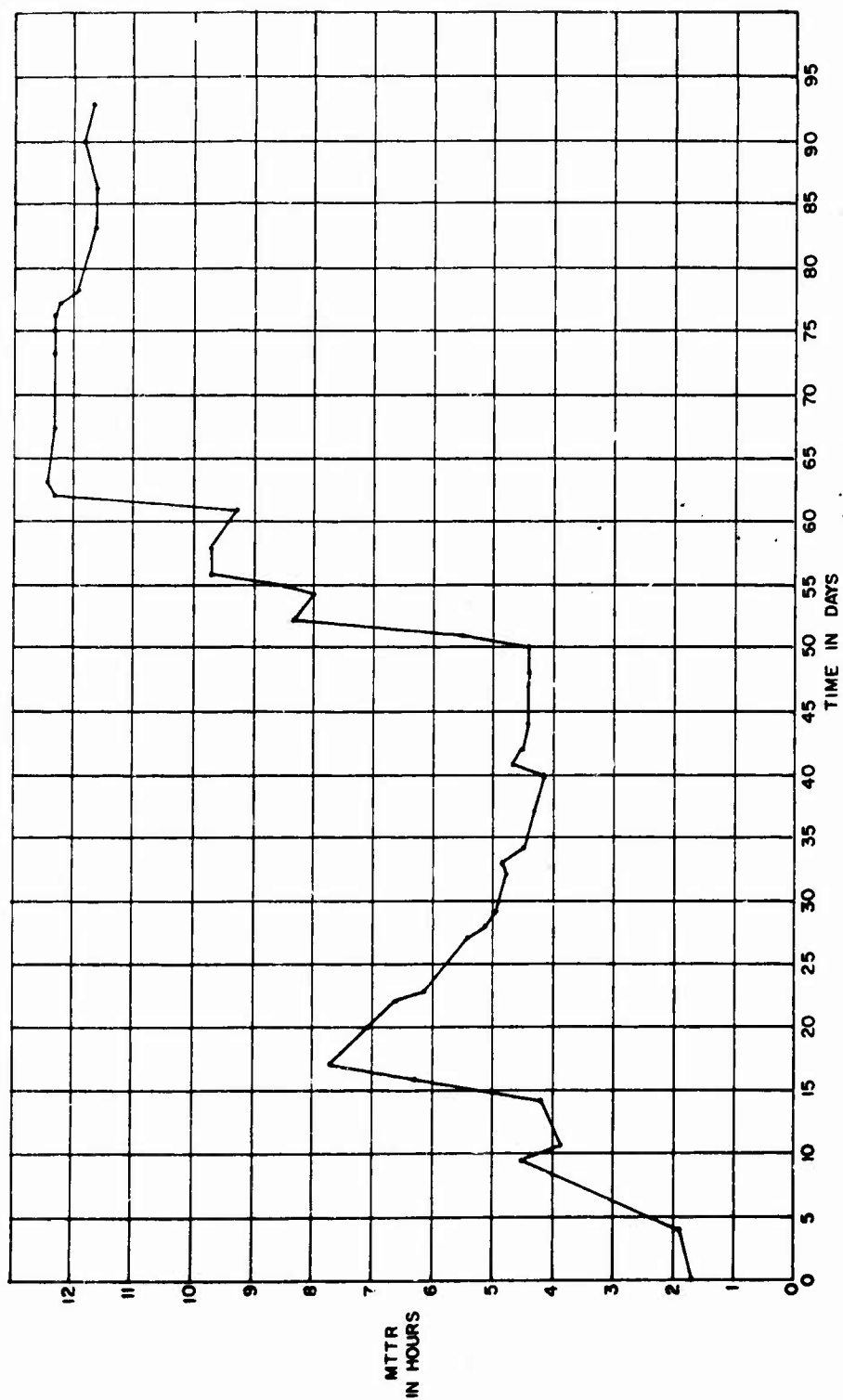


FIGURE 3-5. (U) Time Profile of Mean Time To Repair (MTTR)

(3) Maintenance and repair time was inefficiently expended when spare parts and test equipment were not available or delivered in a defective condition. These occurrences are described in Paragraph 25.

(4) Several errors and omissions were detected in the preliminary operating and maintenance manuals. While their effect on MTTR can not be established, these errors and omissions are discussed in Paragraph 26.

(5) Special tools were constructed by the NMTI for repair of recurring failures for which no tools or inadequate tools were provided. These are described in Appendix D.

(6) Five serious failures that occurred between the 51st and 62nd day of the evaluation accounted for 331.4 maintenance hours. These five failures, which required over 40-hour repair time each and controlled the final level of the curve, are indicated in Paragraph 28, Tables 3-1 to 3-4.

24. (U) MAINTAINABILITY

Maintenance requirements found to be unduly time-consuming by virtue of sequential steps involved, inaccessibility, or number of personnel required to accomplish the task are discussed below.

a. Boresighting. This maintenance action was performed nine times during the evaluation; it required a four-man team and an average of 11.8 man-hours. The major procedures involved are summarized below.

- (1) Aligning helicopter with boresight target board.
- (2) Leveling helicopter, M60 sight and boresight target board.
- (3) Aligning AN/ASQ-132 to first target.
- (4) Aligning RV and DV separately to respective targets.
- (5) Aligning M134 gun to respective targets.
- (6) Aligning M134 gun to "stow" position targets.
- (7) Aligning rocket pods to respective targets.
- (8) Aligning searchlights to respective targets.

This procedure was required for both preventive and corrective maintenance.

b. Purging. The AN/ASQ-132 periscopes required purging on five occasions. This operation was necessary whenever the interior of a peri-

scope had been exposed to the atmosphere, or when the desiccant showed discoloration. The desiccant was visible in a windowed compartment located on the lower half of the RV and DV periscopes. This operation required 1 man-hour to connect and disconnect the nitrogen delivery hoses and 5 hours of purging with nitrogen to insure moisture dissipation.

c. Remote View Subsystem Alignment. Whenever an RV camera or subsystem was replaced or installed, the detailed alignment procedure as specified in the prescribed maintenance manual was required. This operation consisted of 109 steps and required approximately 20 man-hours of effort. The details are available in POMM 11-5855-208-34/1, pp 3-210 through 3-228. This corrective maintenance procedure was performed three times.

d. Removal and Installation of Periscope Electronics Box. The time required for removal or installation of the periscope electronics box (P/N 3166900) was judged to be excessive. This component was located in the center casting of the periscope assembly (001 unit). Access to the electronics box was frequently required during troubleshooting when checking test signals to and from it. Checking test signals in the electronics box required its removal from the center casting. In order to do this, the high voltage power supply (003 unit) and periscope access cover first had to be removed. Once access was gained to the electronics box, difficult manipulations were required in order to disconnect its cable connector and remove it from the 001 unit. Extracting and replacing the periscope electronics box normally required 2 man-hours. Repositioning of this unit is required in order to improve access to the cable connector. An alternative solution might be the addition of integral test leads from the periscope assembly housing surface to the unit or built-in test equipment (BITE) to permit access to the electronics box circuits.

e. Removal and Replacement of Periscope Gear Assemblies. Because of design characteristics, the DV periscope gear assembly mounting screws (Figure 3-6) were not easily accessible. An aggravated situation existed when working on the RV periscope gear assembly because the proximity of the fiber optic bundle (Figure 3-7) further reduced the working area. The fiber optic bundle hindered viewing the work area and created unusual working angles to gain access to the gear assembly. This corrective maintenance procedure was performed five times for a total of 86.5 hours.

f. High Voltage Power Supply (003 unit). During troubleshooting and maintenance checks of the AN/ASQ-132 subsystem, it often became necessary to disconnect and check the high voltage power supply (HVPS). To accomplish this, the HVPS was removed from the center casting of the periscope assembly. This unit was extremely difficult to reinstall. The high voltage leads, from both the RV and DV turrets, were connected into the HVPS. When inserting the HVPS into the center casting, the high voltage leads were often pinched as the component was secured in place (see Figure 3-8). This condition led to the failure of one or both sensors. Even though great care was taken, maintenance personnel could not be sure

the cables were in a safe position. The inability to detect proper placement of cable was due to the fact that, as the HVPS is inserted, it blocks the only opening that allows a complete view of the cables. The addition of another opening, as indicated in Figure 3-9, could correct this situation. With the aid of this additional access, the HVPS could be installed and the necessary connection accomplished expeditiously.



FIGURE 3-6. Location of Inaccessible Assembly Bolts



FIGURE 3-7. Inaccessible Gear Assembly Housing, Remote View Turret



FIGURE 3-8. Cramped Cabling Around High Voltage Power Supply



FIGURE 3-9. Location for Additional Access Panel, Periscope Assembly

g. Assembly and Disassembly of Periscope Assembly (001 unit)

Difficulty was experienced in removing the outboard periscope sections due to the awkward positions of different pieces of hardware. The need for certain types of tools not commonly found in military tool boxes was apparent.

(1) Four screws are located between the center casting and the two outboard castings at the rear of the periscope assembly and join the outer periscope assemblies to the center casting. These screws are positioned (see Figure 3-10) where there is only approximately 1 to 1½ inches of clearance between the walls of the periscope mounting assembly and the RV and DV periscope attaching flanges. The screws themselves are slightly more than an inch in length; consequently, installation or removal of the screws is extremely difficult and time consuming. Special shortened Allen wrenches (see Figure 3-11) were fabricated by maintenance personnel to expedite removal and installation of the RV and DV periscope assemblies. All maintenance teams should be equipped with these special tools before attempting periscope maintenance. A complete set of Ball-Allen screwdrivers (see Figure 3-11) and regular Allen wrenches in sizes not normally issued in TK-100 and TK-105 military tool kits (5/32", 3/16", 9/64", 7/32", and 7/64") are required and should be provided. Tool Kits presently contain an Allen Wrench Set manufactured by Eandhus Tool Company. An Xcelite 99PS-40 Allen Wrench Set contains all sizes needed in INFANT maintenance.

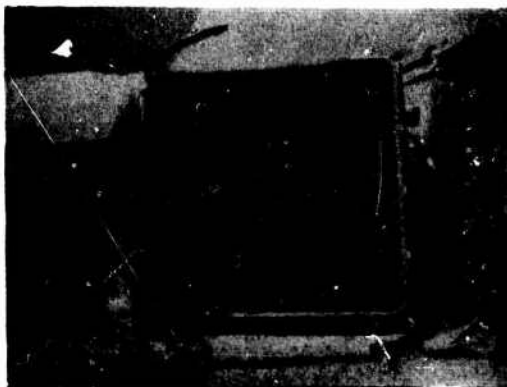


FIGURE 3-10. Location of inaccessible screws on turret assembly

(2) Another area of difficulty during disassembly and installation of RV and DV periscopes was the mating of connectors of the DV and RV subsystems (see Figures 53, 54, and 55 on Pages 3-6 of POMM 11-5855-208-34/2). Two to three people held the outboard periscope sections while another person positioned underneath manipulated these connectors for proper mating with the periscope mounting assembly. The connectors presently terminate with an elbow sleeve, which is awkward to manipulate because of the elbow's interference with other connectors.

h. Dolly Transport of Periscope Assembly. When it was necessary to remove or install the AN/ASQ-132 periscope assembly, difficulty was experienced due to its weight (286 pounds) and the awkwardness and unreliability of the cradle-like dolly platform. The dolly (see Figure 3-12) was designed to lock onto the periscope assembly for the purpose of installation and removal from the aircraft. Once the periscope assembly has been disconnected from its helicopter mounting, it can be moved



FIGURE 3-11. Ball-Allen screwdrivers and modified Allen Wrenches

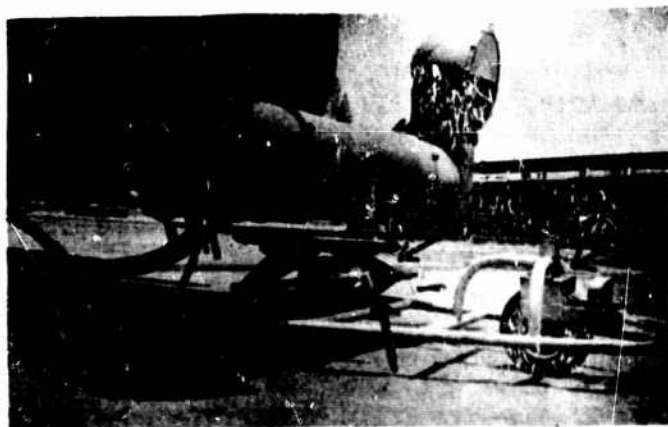


FIGURE 3-12. Weak points on Periscope Assembly Dolly

on the steerable tricycle-wheel dolly. The NETT was supplied with three of these dollies. Even in good working condition the platforms were judged cumbersome and difficult to work with. The main problem was the automobile scissor-type jacks used to raise the cradle under the turret. Personnel adjusting the jacks often became confused with the direction of rotation, since the two cranks rotate in different directions when making the same adjustment. This characteristic resulted in jamming. The jacks were poorly constructed and broke (arrows) while being manipulated. The locking pin devices that secured the underside of the periscope assembly to the dolly (left arrow, Figure 3-12) were very difficult to operate in the close quarters of their location. In general, construction was judged poor from operational standpoint and weak (note arrows, Figure 3-12) from a materiel standpoint. After 3 months of use on semi-improved airfields, these devices were either broken or damaged to a point that their original capability was partially, if not totally, lost. The development of a dolly of improved design or modification of the present dolly is recommended in view of the high cost of the equipment it was designed to carry and hold.

25. (U) AN/ASQ-132 SUBSYSTEM REPAIRS

a. Experience gained in repairing defective components removed from subsystems revealed that, in some instances, there was no means available to check the functioning of the repaired item other than to reinstall it. Examples of this were the searchlight junction box (2 occurrences) and the DV periscope. An AN/ASQ-132 bench test kit is programmed to be made available in the future. It may correct this shortcoming.

b. A complete AN/ASQ-132 subsystem was assembled and installed by maintenance personnel on UH-1M 66-0584 during the evaluation. This was necessary when a modified helicopter, less AN/ASQ-132, was furnished as a replacement for the one lost in combat. The AN/ASQ-132 was assembled from existing spare components and installed as a complete major subsystem. This work required 228 man-hours for installation and repair of defective spares. Completion of the installation, including armament alignment, system alignment, and boresighting, required 62 additional man-hours for a total of 290. Maintenance personnel reported that an excessive amount of time was consumed troubleshooting the system and correcting manufacturing defects of components found during assembly. The most significant among the latter were misalignment of predrilled holes in mating components; failure of components to fit in specified space; improperly assembled wiring harnesses; and failure of individual components to function properly upon checkout at the time of unpacking. It is recognized that the AN/ASQ-132 subsystems evaluated were R&D prototypes, and that components had been fabricated by hand rather than through controlled production processes. The maintenance supervisor's chronological summary of problems encountered in this unique field assembly of INFANT System #4 is provided in Appendix E.

c. During the testing period, 70.3 GS maintenance man-hours were expended on the repair of substandard spare parts supplied by the contractor. For example, the following parts needed repair prior to first use: one A-7 card, two A-13 cards, and two A-15 cards, all for the signal data processor; three A-7 cards and three A-4 cards for the electronic stabilization control amplifier. In addition, standoffs located inside the low voltage power supply had to be lowered prior to use because they were in contact with the casting.

d. The fabric sleeve used to prevent water from working up the AN/ASQ-132 cable harness between the periscope and helicopter fuselage (see Figure 3-13) deteriorated rapidly. This allowed the wind to force water into the helicopter avionics compartment when in flight.

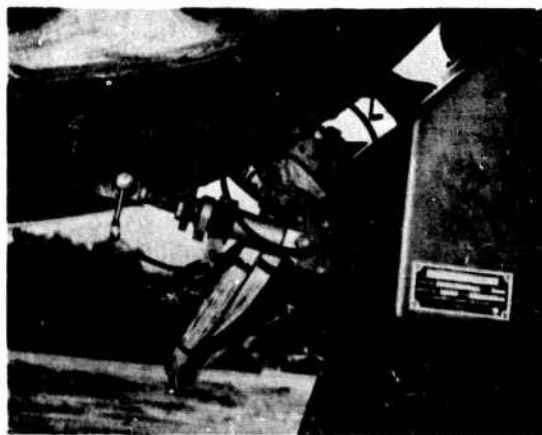


FIGURE 3-13. Deteriorated Cable Sleeve

e. Several relief valves (see Figure 3-14) were faulty. The spring steel retainer was easily jarred loose in normal handling of chests equipped with this model relief valve. Another type of relief valve found on some AN/ASQ-132 equipment chests proved completely satisfactory.

f. During a period of rainy weather, water accumulated inside the searchlight. This water was visible only when the xenon light was turned on. In an attempt to determine whether the water entered during flight or while the aircraft was parked outdoors, a cover was improvised and placed over the complete searchlight housing when the aircraft was parked (see Figure 3-15). Unfortunately, this was done just as the rainy season terminated, and no conclusions could be drawn. The new cover also provided some protection against the accumulation of blown dust on the cooling fan grills at the rear of the housing.

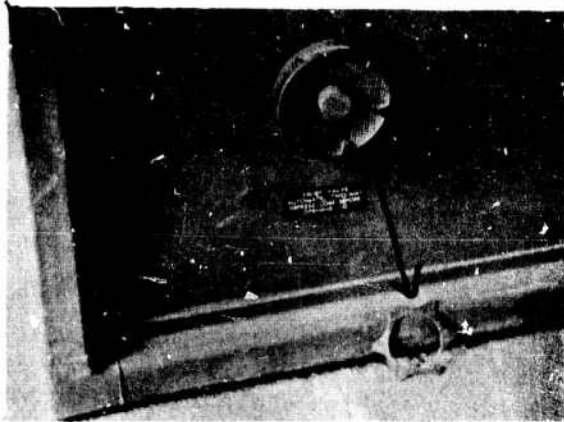


FIGURE 3-14. Defective Pressure Relief Valve, Carrying Case

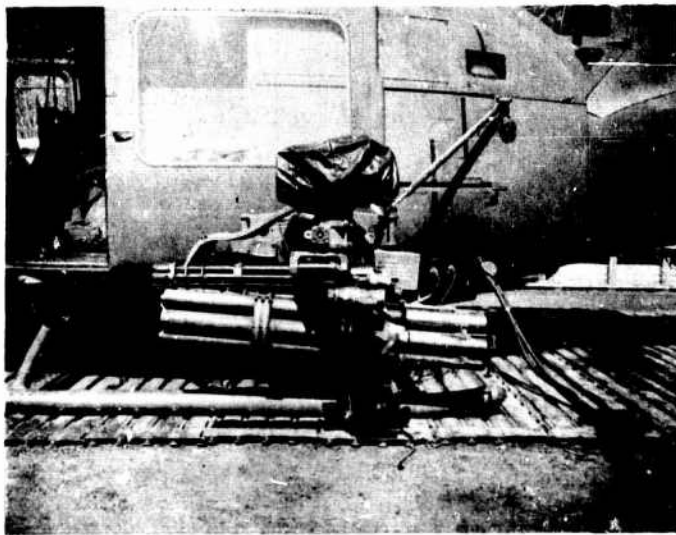


FIGURE 3-15. Improvised Searchlight Cover

26. (U) MAINTENANCE PUBLICATIONS

POMM publications originally furnished were replaced by revised editions during the evaluation. The revised POMM did not account for numerous design changes incorporated into INFANT prior to deployment. The comments noted below pertain to the revised documents.

a. POMM 11-5855-208-34/1, Direct and General Support Maintenance.

(1) Chapter 2 contains interunit circuit analysis, stage analysis, and a discussion of power distribution. This chapter was not generally used in performance of maintenance; however, it did provide

useful information enhancing general knowledge of the system.

(2) Chapter 3 contains direct support information for use in troubleshooting. The information provided assists technicians in determining cause of malfunction. The procedures generally proved to be inadequate for use by maintenance personnel.

(a) Errors were repeatedly found in the procedures section. For example, "Measure voltage between plug 1, pin J and plug 1, pin H." Measurement should have been between plug 1, pin J and plug 1, pin E. Some instructions were impossible to accomplish. For example, "Connect voltmeter between TP5 (+) on chassis and test point TP3 (-) on card A-2 of the INFANT control panel (012 unit)." Test point TP5 should have read TP4 as there is no TP5 on the equipment. Typographical errors of this type caused unnecessary confusion and increased troubleshooting time.

(b) In the section of the POMM titled Proper Indications, the following errors were noted.

1 Several notations direct the measurement of AC voltage where it should have indicated DC voltage.

2 One statement, "AC voltage proportional to turret (004 unit) elevation position" gives insufficient information for maintenance personnel to act on, and there were no other references or examples given to clarify the statement.

3 Another statement indicates, "Negative voltage drives turret (004 unit) up," when in fact "up" should have read right.

(c) Some errors noted in the Possible Component Failure section were:

1 "Defective relay K5 on the chassis of the signal data processor (008 unit)." It was discovered that the K5 relay had been removed from the unit's design.

2 "Defective INFANT control panel (012 unit)." When technicians measured between +30 volts and ground on the signal data processor, as stated, and the +30 volts was not present, the system control panel (012 unit) was not defective as indicated in the POMM. Rather, a defective low voltage power supply (010 unit) caused the problem.

b. POMM 11-5855-20°-34/2, Direct and General Support Maintenance Manual consisted of block diagrams, schematics, and plan-views of part location. This POMM could not be used properly because of an excessive amount of errors in the schematic section.

27. (U) MEAN-TIME-BETWEEN-FAILURE

a. The mean-time-between-failure (MTBF) was determined for only the AN/ASQ-132 ("failure" is defined in Paragraph 23a). "Mean time between failure" is defined as follows: "For a particular interval, the total functioning life of a population of an item divided by the total number of failures within the population during the measurement interval. The definition holds for time, cycles, miles, events, or other measures of life units." (AR 705-50)

b. During the 94-day evaluation period, 4 AN/ASQ-132 subsystems operated for 333 hours and experienced 54 failures, accounting for an MTBF of 6.2 hours. Figure 3-16 shows a time profile of MTBF. Each point on the curve represents MTBF calculated by considering the total number of failures and operational hours from the beginning of the evaluation until the point in time under consideration.

c. The curve was dependent on the following data:

(1) Recurring failures, i.e., failures which occurred more than once, accounted for 39% of the total. These failures are discussed in Paragraph 29.

(2) The curve excludes data on 11 spare parts items that were defective prior to use and discovered during assembly of an AN/ASQ-132 from spare parts (Paragraphs 25b and c). If these are included, the MTBF for the entire evaluation becomes 5.2 hours.

28. (U) RELIABILITY (AN/ASQ-132 only)

a. The AN/ASQ-132 system failures that occurred during the evaluation were divided into four functional categories: remote view, direct view, searchlights, and those common to both the remote and direct view subsystem. A summary of failures is contained in Tables 3-1 through 3-4. The numbers appearing in parentheses after a failure indicate the day of the evaluation on which the failure occurred. Multiple numbers indicate multiple failures. In these cases, the man-hours figure reflects the average time spent per failure.

b. Failures that occurred two or more times are listed in Table 3-5.

29. (U) MULTIPLE FAILURES (Table 3-5)

a. On three occasions, the gimbal angle indicator failed to show the position of the periscope. In two instances, maintenance personnel found the S-1 switch, A-13 card of the signal data processor switched inadvertently to the zero position. The cause was undetermined. When in this position, the S-1 switch kept the gimbal indicators on the monitors in the zero elevation and zero azimuth position.

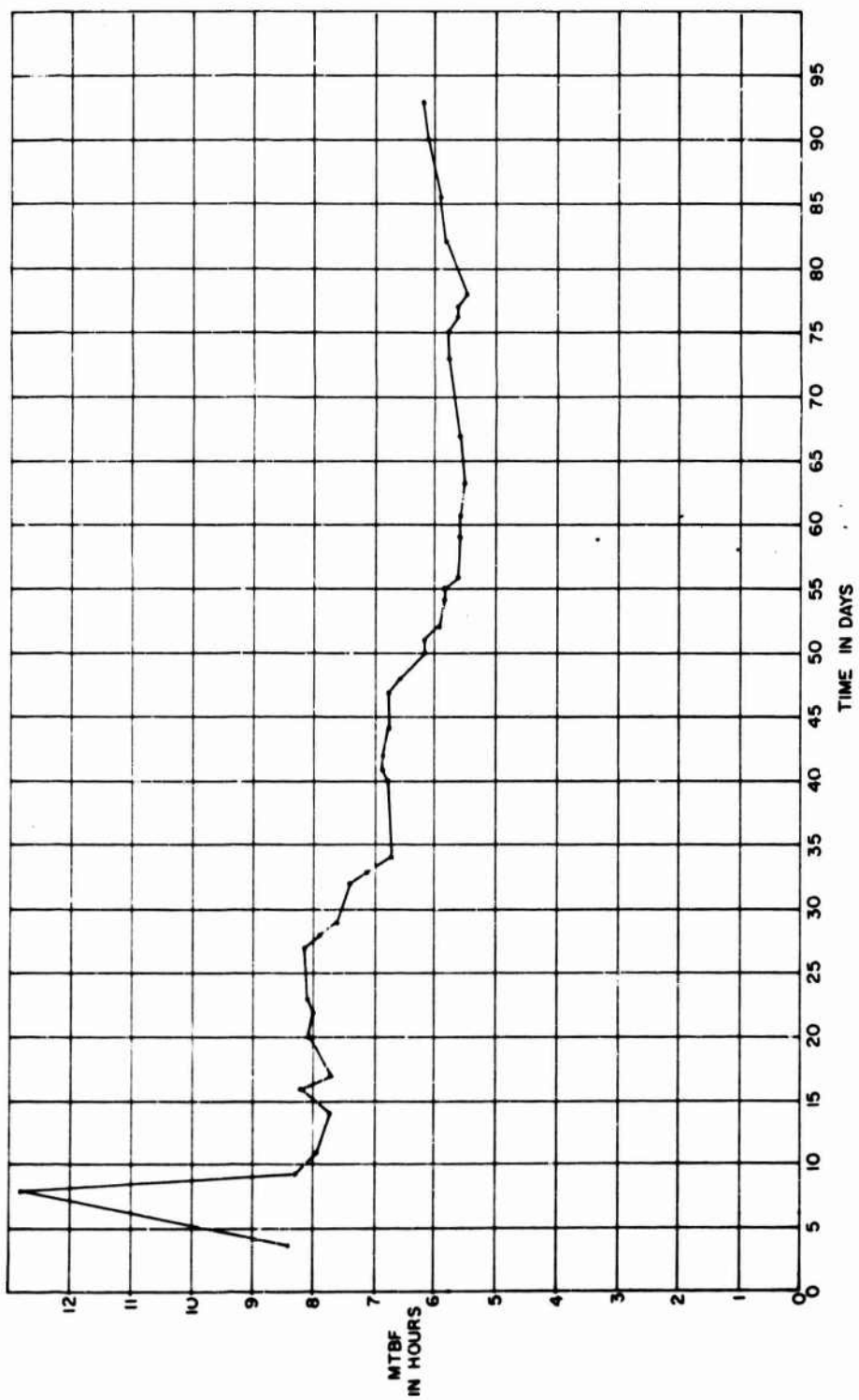


FIGURE 3-16. (U) Time Profile of Mean Time Between Failures (MTBF)

TABLE 3-1.

REMOTE VIEW SUBSYSTEM FAILURES

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
1. Shutter would not close (0).	Removed RV turret & returned to Depot.	4.5		
2. Gimbal angle indicator would not move vertically or horizontally (0, 9, 54).	Adjusted switch S-1 on A-10 card.	1.7		
3. Gimbal angle indicator would not move horizontally (73).	Checked signals of gimbal indicator.	10.5		
4. Turret oscillated (16).	Removed & replaced low voltage power supply.	1.0	Repaired low voltage power supply.	21.7
5. Shutter would not open (22, 37).	Repaired & cleaned iris motor brushes.	5.5		
*6. Discharge switch would not clear up image (67).	Replaced A-7 card of signal data processor.	1.5	Repaired broken wire to pin U on A-7 card.	1.7
7. System would not focus in three fields of view (42).	Removed & replaced NR 3 card of the high voltage power supply & returned to depot.	1.5		
8. Pilot monitor operated intermittently (44).	Ground-checked and found working correctly.	1.0		
9. No raster & no video on observer monitor (48, 50, 51).	Removed & replaced monitor.	.5	Repaired monitor.	4.4

TABLE 3-1.

REMOTE VIEW SUBSYSTEM FAILURES (CONT)

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
10. Field of view did not change correctly (75).	Cleaned high voltage leads from camera.	2.5		
*11. Logic problem on A-4 card (83).			Replaced missing diode.	1.0
*12. No output pin 4 A-1 card on Signal Data Processor (62).	Removed conformal coating on pin.	1.0		
13. Image on monitor unstable, derotation oscillating (78).	Repaired cover crimped wires in electronic stabilization control amplifier.	6.0		
14. Picture would not focus or zoom (34).	Removed & replaced field of view & switch.	1.3		
15. INFANT circuit breaker would pop when RV system was turned on (90).	Removed & replaced pilot monitor.	2.0	Repaired frayed wire in monitor.	11.3
16. Signal data processor smoking (32).			Removed & replaced R-52 resistor.	1.2
17. Defective elevation gear box (86).	Removed & replaced, re-turned to depot.	21.5		
*18. Plug 73 would not mate with connector 73 (62).	Connector 73 rotated 90°.	18.0		

*Manufacturing faults discovered in assembly of System 4.

TABLE 3-2.

DIRECT VIEW SUBSYSTEM FAILURES

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
1. Shutter light blinking on & off and shutter would not open (4).	Removed & replaced low voltage power supply.	.5	Removed & replaced zener diode.	1.6
2. Shutter opened automatically (11).	Removed & replaced A-15 card of signal data processor.	3.6	Removed & replaced relay K-1 of the A-15 card.	3.5
3. Shutter would not open (14, 28).	Ground-checked and found working correctly.	1.3		
4. Turret would not operate vertically (17, 58, 77).	Removed & replaced elevation drive motor & returned to depot.	20.2		
5. Brightness control inoperative (22).	Resoldered broken wire.	.9		
*6. Shutter would not open (62).	Removed turret & re-paired shutter (24.3 hrs depot maintenance).			
*7. Plug 29 would not mate with connector 29 (62).	Removed epoxied elbow from plug 30.	18.0		
*8. DV turret would not mate properly with center casting (62).	Removed metal to enlarge I.D. of center casting.	12.0		

TABLE 3-2.

DIRECT VIEW SUBSYSTEM FAILURES (CONT)

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
*9. Copilot monitor mounting bracket would not align (62).	Redrilled holes in mounting bracket.	2.0		
10. No image in DV system (29).	Repaired high voltage lead from camera.	1.4		
11. Insufficient light on image (33).	Repaired insulation on high voltage lead on camera.	6.0		
12. Double image on system (51).	Removed & replaced turret head.	11.4	Cleaned fiber optic rope & camera and reassembled.	29.5
13. Camera inoperative (52).			Removed camera from turret head & replaced; returned camera to Depot.	90.5
14. Shutter would not open; turret locked in full right and full down position (55).	Removed & replaced low voltage power supply.	3.5	Repaired low voltage power supply.	35.7
15. Turret oscillated vertically only (56).	Removed & replaced tachometer and returned to depot.	14.5		
16. Right gun would not track with system (56).	Repaired A-3 wire of gun command potentiometer R-35.	6.5		

TABLE 3-2.

DIRECT VIEW SUBSYSTEM FAILURES (CONT)

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
*17. Camera derotation motor continually turned from one limit to the other (62).	Repaired intermittent wiring connection.	120.0		
18. Image would not derotate (63).	Removed & replaced motor brake assembly & returned it to Depot.	17.0		
19. Turret would not move vertically (76).	Repaired over crimped wire, Pin B, of the elevation drive motor.	9.5		
20. Turret locked in full down position (78).	Cleaned pin 11 of signal data processor and re-paired pin 11 of card socket.	1.6		
*Manufacturing faults discovered in assembly of System 4.				

TABLE 3-3.
SEARCHLIGHT SUBSYSTEM FAILURES

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
1. Searchlight inoperative (8, 14, 40).	Removed & installed junction box & re-turned one box to depot.	2.0	Repaired booster assembly.	7.8
2. Left searchlight inoperative (41).	Removed & replaced searchlight.	1.9	Repaired searchlight.	7.0
3. Right searchlight inoperative (47).	Removed & replaced junction box.	1.1	Adjusted R-6 on A-4 card.	2.2

TABLE 3-4.

REMOTE VIEW/DIRECT VIEW COMMON SUBSYSTEMS FAILURES

FAILURE	DIRECT SUPPORT	MAN HOURS	GENERAL SUPPORT	MAN HOURS
1. Switches stuck on INFANT control panel (9, 20, 23, 27, 34, 40, 61, 61).	Cleaned switches.	.8		
2. Both systems became inoperative in flight (54).	Ground-checked & flight-checked; found operable.	3.3		
3. Both systems oscillated vertically & horizontally (56).	Removed & replaced A-12 unit of electronic stabilization control amplifier.	38.0	Repaired A-12 unit.	2.0
4. Guns followed wrong turret (83).	Installed missing diode in gun logic.	1.0		
* 5. No 400 Hz power (62).	Rewired K-105 relay.	40.0		
* 6. AN/ASQ-132 would not operate from A/C power in flight (62).	Rewired K-4 relay.	8.0		
*Manufacturing faults discovered in assembly of System 4.				

TABLE 3-5.

MULTIPLE FAILURES

FAILURE	HOURS OF USE AT TIME OF FAILURE*	SYSTEM NUMBER
a. Gimbal angle indicator inoperative.	18.7 41.5 15.5	2 3 2
b. Shutter would not open (RV).	29.7 119.8	2 3
c. Shutter would not open (DV).	42.2 58.3	3 2
d. Turret would not operate vertically (DV).	45.6 77.2 9.2	2 3 4
e. No raster/video on observer monitor.	89.2 117.1 45.8	3 2 1
f. Searchlight inoperative.	8th night** 14th night** 40th night**	3 3 3
g. Control panel illuminated push button stuck.	9 missions**	

* Hours of operation since evaluation start or last failure, as appropriate.

** No elapsed time recorded.

b. On two missions, failure of the iris motor caused the remote view shutter not to open. Before the shutter can respond to a command to open, the iris motor must first close the iris. In these instances, the motor brushes were found to be excessively worn and the armature dirty. This prevented the motor from developing the required torque to close the iris. The iris opened and closed properly after maintenance was performed on the motor. Actual operating time was not sufficient to account for the wear found on brushes.

c. There were two mechanical failures of the shutter in the direct view turret lens assembly. Major action was taken on one failure when the NET Team performed depot maintenance with the advice and help of a contractor field service representative. Alternatively, the periscope assembly would have had to be shipped to CONUS for depot maintenance and return to RVN. This would have taken approximately 30 days. Five days were required to repair the shutter in the field. This action improved the availability of INFANT.

d. The DC drive motor of the elevation gear assembly failed on three occasions. On two missions, the motor failed to drive the turret either up or down. Examination indicated that both windings in the motor were burned. On the third occasion, the motor failed to move the turret in the up direction. Examination revealed that the wires were burned on only one side of the motor.

e. On three occasions, the observer's remote view monitor failed. Examination showed that there was no horizontal drive signal reaching the cathode ray tube.

f. The booster assembly of the searchlight junction box (904 unit), SN7, caused the failure of searchlights on three occasions. The same three components of the booster assembly were the cause of these failures. These were: boost assembly transistor, Q1; boost assembly transistor, Q2; and boost assembly resistor, R1. Spare parts did not include booster assemblies. This item was returned to the depot for analysis and repair but no report of the analysis was received. Pending improved reliability of the booster assembly, this item should be included in the spare parts kit.

g. The illuminated push buttons (see Figure A-11, Appendix A) on the AN/ASQ-132 control panel (012 unit) were a problem to operators on nine missions. The buttons stuck in the down position. Maintenance personnel found that dirt and sand lodged between the push buttons and their housing caused the failure. Daily cleaning by both technicians and aircraft crew chiefs helped prevent this problem. Unless this shortcoming can be corrected, this type of switch should not be used in a helicopter environment.

h. A failure that persisted throughout the evaluation was the shrinkage of the membrane material used in the original neutral density

filters. These filters consisted of two circular plates of clear glass with a dark cellophane-like membrane between them. They serve to restrict the amount of daylight entering the sensor so that the AN/ASQ-132 subsystem may be operated for demonstration and maintenance purposes in daylight. Although these filters did not affect nighttime operations and were not included in failure calculations, their failure did hamper daylight maintenance and training. Shrinkage first appeared around the edges of the membrane and quickly spread toward the center of the filter. In the early stages of shrinkage, black paint was used on the glass to cover the breaks in the membrane and keep the filter operational. As shrinkage continued, this method was discarded because the cumulative effect of the painting process eventually reduced the light passage to an unacceptably low level. Shrinkage was believed to have been stimulated by the environment present in Vietnam.

30. (U) OPERATIONAL EFFECTS OF FAILURES

In the preceding paragraphs, analysis was performed to show the effect of failures on maintainability and reliability. This paragraph deals with the effect of failures on operations.

a. Summary of Failures Noted During Operational Missions.

- (1) Failure of both the DV and RV subsystems during the first sortie of the night caused the mission to be aborted.
- (2) Three missions were aborted because the DV subsystem elevation control was inoperative. The missions could have been performed using only the RV.
- (3) DV shutter would not open and sortie was aborted. Mission was subsequently aborted because of lack of coordination with ground units.
- (4) AN/ASQ-132 control panel push buttons stuck and sortie was aborted. Mission was completed after buttons were cleaned.
- (5) DV shutter occasionally stuck closed during mission, but the mission was not aborted. Recycling of subsystem eliminated problem.
- (6) Failure of one searchlight on two different missions limited visibility under starlit conditions. Missions were not aborted.
- (7) Pilot's monitor cycled to "off" several times during mission. Mission was impaired but not aborted.
- (8) DV image was lost during last sortie of mission. Mission completed using only remote view sensor.
- (9) Due to the loss of the gimbal indicators on four separate missions, pilots were unable to determine the direction in which the turret

was pointing. No missions or sorties were aborted due to this.

(10) Both searchlights failed on a partially moonlit night, but this did not affect the mission.

(11) A double image on the DV subsystem was reported at the end of night's mission.

(12) AN/ASQ-132 control panel push buttons stuck on eight missions, but did not affect any of them.

(13) DV shutter opened automatically when subsystem was turned on, but this did not affect the mission.

(14) Brightness control on DV subsystem failed during mission, but no abort.

(15) RV image would not focus or zoom while INFANT was en route to mission area. Aircraft returned to home station, problem was fixed, and INFANT returned to perform mission.

b. Summary of Failures Occurring During Normal Readiness Inspections.

(1) AN/ASQ-132 would not zoom or focus properly in three fields of view (noted during system checkout in morning).

(2) DV periscope oscillated vertically at approximately 8Hz (noted during morning system checkout).

(3) Broken insulation on DV camera lead (noted during morning system run-up).

(4) On two occasions, the RV shutter failed to open during morning checkout.

(5) A-4 card of the signal data processor (008 unit) failed during troubleshooting of earlier failure.

(6) RV field of view switch failed to zoom image (noted during morning checkout).

(7) A short in the pilot's monitor caused circuit breaker 108 to open (noted during INFANT 100-hour periodic maintenance check).

(8) RV and DV turrets oscillated in both azimuth and elevation (occurred while boresighting).

(9) Right minigun did not follow DV positioning commands (noted during boresighting).

(10) RV derotation oscillated at about 4 Hz (noted during boresighting).

(11) DV turret locked in full down position (occurred during boresighting).

(12) Observer monitors failed three times during preparation for demonstrations.

(13) DV derotation failed during system checkout prior to a demonstration.

(14) One low voltage power supply was repaired to correct a failure prior to the evaluation period.

(15) One searchlight junction box was repaired to correct a failure prior to evaluation period.

(16) Searchlight junction box failed when tested on subsystem after repair.

(17) A turret gear box failed as the result of an aircraft hard landing (detected during inspection for possible damage).

(18) The low voltage power supply failed during the installation checkout of system number one.

(19) The A-7 card of the signal data processor (008 unit) failed during the installation checkout of system number four.

(20) The A-4 and A-7 cards of the electronic stabilization control amplifier (009 unit) did not function properly. Failure was noted during installation checkout of system number four and was attributed to missing component.

(21) DV shutter would not open. Failure was noted during installation checkout of system number four.

(22) Failure of relay K105 and relay K4 to respond correctly due to miswiring by the manufacturer (noted during assembly of system number four).

(23) DV derotation oscillated at about 2 Hz (failure noted during installation checkout of system number four).

(24) Four miscellaneous failures of cables and end items to properly mate were noted during installation of system number four.

(25) A-1 card of the signal data processor failed to give an output on pin number four (failure noted during alignment of system number four).

(26) DV failed to follow elevation commands (failure noted during checkout of spare DV turret).

(27) DV camera arcing occurred (failure noted during checkout of spare DV turret).

(28) DV periscope went to full down and full right position (failure noted during morning checkout).

(29) RV shutter failed to close (failure occurred prior to the evaluation period).

31. (U) PROTECTIVE DEVICES

a. The AN/ASQ-132 was equipped with a number of protective circuits that prevented accidental damage to the vital parts of the system. One such device was flashing crosshairs which appeared on the RV displays when outside light levels were too high, or if a light source that would cause permanent burn damage to the vidicon tube was present. The flashing signal lasted 30-seconds, after which the subsystem light shutters closed. However, the shutters closed automatically independent of the 30-second warning signal if the signal circuit failed. Both RV and DV were equipped with this shuttering action, but the DV lacked warning crosshairs, since its crosshairs were etched onto an element of the eyepiece, whereas the RV crosshairs were electronically generated.

b. Excessive light could easily damage the image intensifier tubes of the AN/ASQ-132. Logic circuits, found in the signal data processor (008 unit), considered many operational factors affecting system safety before allowing the AN/ASQ-132 to respond to a command to open shutters. If any one of many harmful conditions was present, the system would not respond. This activated a fail indicator, alerting the crew to the condition.

c. AN/ASQ-132 circuits were adequately protected from surges of power by an overvoltage absorber (017 unit). This unit, located in the battery compartment along with the AN/ASQ-132 circuit breakers, also supplied filtered 28VDC to the low voltage power supply. The overvoltage absorber was an extremely reliable unit; it had no failures. However, location of the circuit breakers in the battery compartment was considered a shortcoming because the AN/ASQ-132 power could not be cut off at its source in the event of an inflight electrical fire.

SECTION IV

OBJECTIVE 3 - HUMAN FACTORS AND TRAINING

32. (U) OPERABILITY OF CONTROLS

The INFANT controls were found to be adequate from a human factors point of view. However, a few shortcomings were noted.

a. One of the problems mentioned most frequently was that the AN/ASQ-132 controls (012 unit) on the helicopter pedestal were poorly located and identical in shape (see Figure 1-5, A-10, and A-11). Because the individual push buttons are difficult to differentiate by touch alone, several instances occurred in which operators inadvertently activated the "Off" and "Stow" buttons on the control panel when attempting to activate "Boresight" just prior to rocket firing. This resulted in abortion of rocket runs and, on occasion, caused the operator to lose visual contact with the target area during the turn-around for subsequent firing run. During the latter portion of the evaluation, a hinged sheet metal shield was fabricated and placed over the "Off" and "Stow" buttons (Figure 4-1). This modification prevented accidental activation of the wrong button.

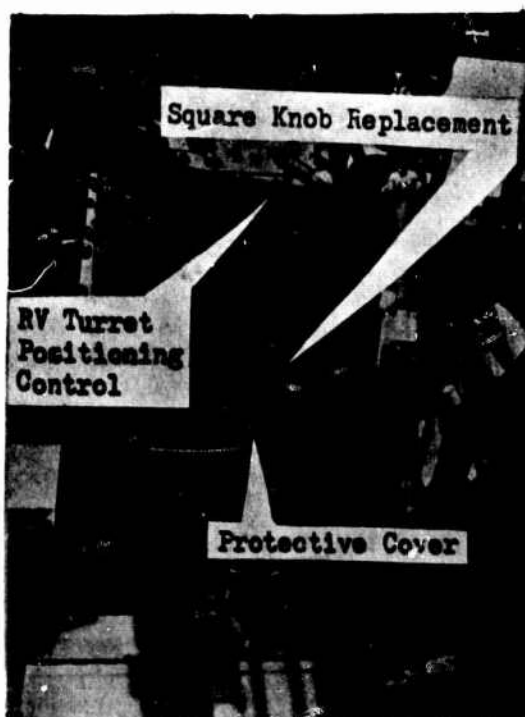


FIGURE 4-1. Field Expedient Modifications to Control Panel

b. The push buttons on the AN/ASQ-132 control panel (012 unit) jammed on numerous occasions; one occurrence resulted in the abort of a sortie. This condition was caused by dust and dirt accumulating in the push button wells. It was a continuing problem because of the constant dust in the helicopter operational environment. This situation became increasingly distracting to the heavily burdened operators. Efforts to develop a field expedient flexible protective cover for the buttons were unsuccessful. Rubber from surgical gloves was installed over the buttons in an effort to keep dirt out but heat from the illuminating bulbs caused the rubber to deteriorate rapidly and no longer serve its intended purpose. Initially, however, this flexible cover was effective in keeping dust and

dirt from the button wells. Development of a flexible seal to eliminate this problem should be pursued, because this type of control device is desirable for use in aircraft.

c. There are three identically shaped round knobs on the AN/ASQ-132 control panel (012 unit). Two of these are adjacent to each other. This contributed to selection of the wrong switch on numerous occasions. Because the three switches are located close together at the side of the operator, individual identification by touch was difficult. Furthermore, even under normal circumstances, the operator could not safely divert his attention away from the instrument panel to read the knob labels. A field expedient to alleviate this situation was the replacement of one of the knobs (RV Mode) with a square knob from the helicopter light control panel (see Figure 4-1). This enabled quick identification by touch alone.

d. The fiber optic bundle (DV subsystem), when attached to the M6 Sighting Station, proved to be awkward to handle. Operators complained of left arm fatigue from constant pressure required to hold the DV display in viewing position. In addition, the position of the eyepiece required the copilot/gunner to lean forward while viewing through the DV. This usually resulted in backaches after 4 to 5 operating hours.

e. Pilots reported difficulty in communicating the relative position of targets detected on the RV to the copilot/gunner. Although the pilot can rapidly slew the RV to the same line of sight as the DV by placing the mode switch in "M6", the copilot/gunner cannot activate a control that will align the DV with the RV line of sight. This situation precludes maximum utilization of the copilot/gunner and negates the firepower of the miniguns for targets detected by the RV.

33. (U) POSITIONING OF EQUIPMENT

The AN/ASQ-132 controls were installed in the UH-1M with only minor modifications to the helicopter. Some problems arose as a direct result of the positioning of equipment in the aircraft.

a. A shortcoming reported to have been quite disconcerting to pilots was the fact that it is necessary to remove the left hand from the collective pitch control in order to operate the RV "T-handle" (RV turret positioning control, Figure 4-1) and the RV FOV switch. The pilot uses the T-handle and FOV controls almost continuously, resulting in extended periods when he cannot keep his hand on the collective pitch control lever. This situation is detrimental to safe operating practices. The T-handle control function was considered appropriate for incorporation into the cyclic control grip using the inactive "coolie hat" button or a modification thereof. The T-handle could be retained for use by the copilot, although this is not necessary since the M6 mode provides the copilot with a control mechanism for the RV. The space made available through the removal of the T-handle would permit improved location of

other pedestal controls (see Paragraph 33d below). Relocation of the FOV functional control from the 012 unit to the switch box of the collective pitch control was also cited as desirable. The switch should be designed to permit operation requiring only the thumb, while allowing the hand to otherwise remain on the collective. Experience also pointed out the need for simultaneous activation of the T-handle and FOV controls. The present configuration requires the pilot to use his left hand to operate both controls. This results in overburdening use of the left hand, and generally impairs overall effectiveness, hence the suggestions to place the FOV switch on the collective for left hand use, and the RV positioning control on the cyclic for right hand use.

b. Pilots (right seat) frequently reported that their right boot became caught between the floor and the bottom of the RV monitor mount. (see Figure 4-2).

This was encountered mainly when hovering, because of greater movements of the antitorque pedals. This condition could cause an accident, especially when hovering in windy conditions, because more pedal movement than normal is required.

c. Operators were of the opinion that a potential safety hazard exists when the fiber optic bundle (DV) is attached to the M6 Sighting Station (see Figure 1-6). A hard landing could cause chest and facial injuries to the copilot/gunner if the device is not stowed. Operators also expressed concern over the location and hookup of the fiber optic bundle and the M6 Sighting Station. In the event the copilot had to take rapid control of the aircraft in an emergency, the fiber optic bundle and the M6 Sighting Station would be in his way. The present configuration requires unhooking the two items and stowing each separately, a time-consuming task. A quick "knock-away" device should be developed for use in those situations where the copilot needs to take control rapidly, and to permit his rapid exit in an emergency.

d. Repositioning of many control heads on the helicopter pedestal was necessary to accommodate INFANT controls (011 and 012 units).

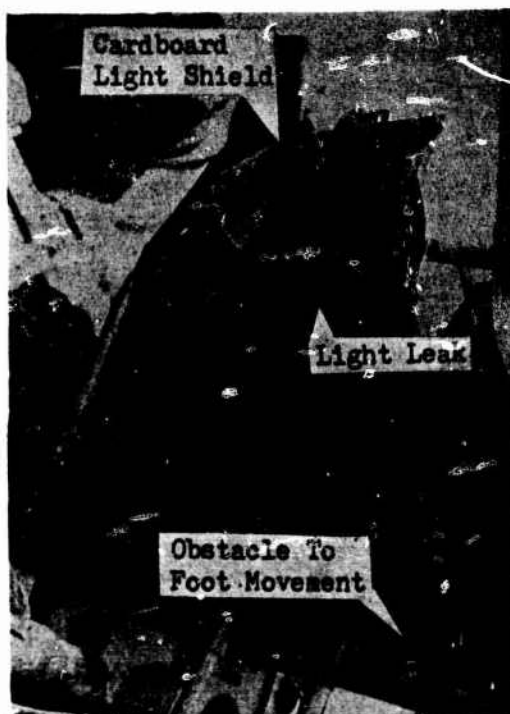


FIGURE 4-2. Remote View Problem Areas

As a result, the FM control head, C-3835/ARC-54, was moved rearward from its normal location into a position judged inaccessible by INFANT pilots. Seat armor shielding was a contributing factor. During INFANT missions, the FM radio was the one most frequently used, requiring many frequency changes. Removal of the 011 unit, T-handle (see Paragraph 33a above), and repositioning of the 012 unit should provide space for a more suitable location of the C-3835 control head.

34. (U) DISPLAY ADEQUACY

a. Operators reported no significant difficulty in interpreting the RV scene as presented. Brightness and automatic light control (ALC) were adequate; however, a wider contrast range was proposed to improve probability of target detection. It is believed that the ability to enhance the contrast ratio of the image depicted on the monitor would improve overall recognition. This becomes more apparent under starlight conditions and when the background scene is of a uniform texture. The position of the RV displays was acceptable.

b. It was determined that the rear monitor was more of a hindrance than a functional aid. There were several reasons for not normally utilizing it during the evaluation:

(1) The glare emitted from the monitor lit up the cockpit area, causing windshield reflections which increased the difficulty of night flying using outside visual reference.

(2) The weight of the monitor was tolerable (39 pounds). However, the additional weight of an observer (200 pounds) to view the monitor was prohibitive, since the helicopter was already operating at maximum gross weight (9500 pounds) with a normal crew of four, including the two side-looking door gunners. Pilots preferred the security afforded by side-looking gunners/observers over that offered by an observer using the rear monitor.

(3) Picture clarity of the rear monitor was judged to be not as sharp as that of the two front monitors. This may be attributed to eye-to-display distances of the respective monitors and the apparently wider spacing between lines on the raster of the rear display. It was also determined that use of the rear monitor and an additional observer did not enhance detection capability. Consequently, the rear monitors were removed during most of the evaluation, except for VIP or training demonstrations, where they proved to be effective. Other than for these limited purposes, further use of rear monitors for INFANT is not recommended.

c. Operators found several reasons why the searchlights were inadequate for improving display quality. The searchlights could only be operated effectively during clear moonless nights, and then only with the two narrowest fields of view (FOV) on both the RV and DV. The

beam spread was too narrow (10 degrees) to use in conjunction with the two wider FOV. Concentration of too much light in the small area of the wider FOV resulted in "washout" of the picture, since the automatic light control (ALC) could not compensate for the extreme contrast between the illuminated and non-illuminated areas (see Figure 4-3). It is desirable that an adjustable beam spread that will illuminate the entire scene be incorporated into the present searchlights. This adjustment feature should be coupled automatically with the FOV selector for the DV and also with the FOV selector for the RV when it is operating in the "IR Aided" mode. The automatic feature is needed to reduce the burden of operator tasks, which is already heavy.

d. Pilots had to rely primarily on instrument flying techniques while using the RV subsystem in order to maintain spatial orientation and avoid the effects of vertigo. However, because of the presence of a real-world picture on the RV monitor, this tended to occupy the pilot's attention an inordinate amount of time and distract from good instrument crosscheck procedures. This was particularly troublesome during firing runs (RV subsystem in the "boresight" mode), when it was necessary for the pilot to concentrate on aligning the display crosshair with the target. Pilots unanimously agreed that some form of integrated display of flight status and command information is needed with the RV. Also, different items of information are required during the various segments of the mission profile (see Appendix F, Mission Profile). Further, there is a need for the presentation of command information upon reaching a preselected minimum altitude determined preferably by a radar (absolute) altimeter. Although actual cause of the loss of one INFANT (UH-1M 66-0726) on 2 January 1970 was not established, three possibilities exist: ground-to-air fire, mechanical failure, or target fixation. Target fixation has been a perplexing phenomenon associated with aerial gunnery over the years. Conditions at night tend to increase its likelihood of occurrence, especially with a real-world picture displayed on the instrument panel. The present INFANT cockpit display system is very fatiguing. As a result, the maximum nightly crew mission time was limited to 6 hours, including time en route. Overall, pilots felt that the present RV monitor and instrument display require a pilot with above-average abilities for safe operation. During all rocket runs, it was normal procedure for both the pilot and copilot to monitor the flight instruments to remain within safe operating limits and to assure pull-out at a predetermined minimum altitude.

e. Next to the recommendation for an integrated display, a wider FOV was reported as being most desirable for both DV and RV. This will assist the pilot in spatial orientation, especially during rapid maneuvering to make additional runs on a target. The widened FOV would provide additional information with respect to attitude control and improve the pilot's ability to judge depth. It might also improve techniques of station keeping with other helicopters equipped for night operations.

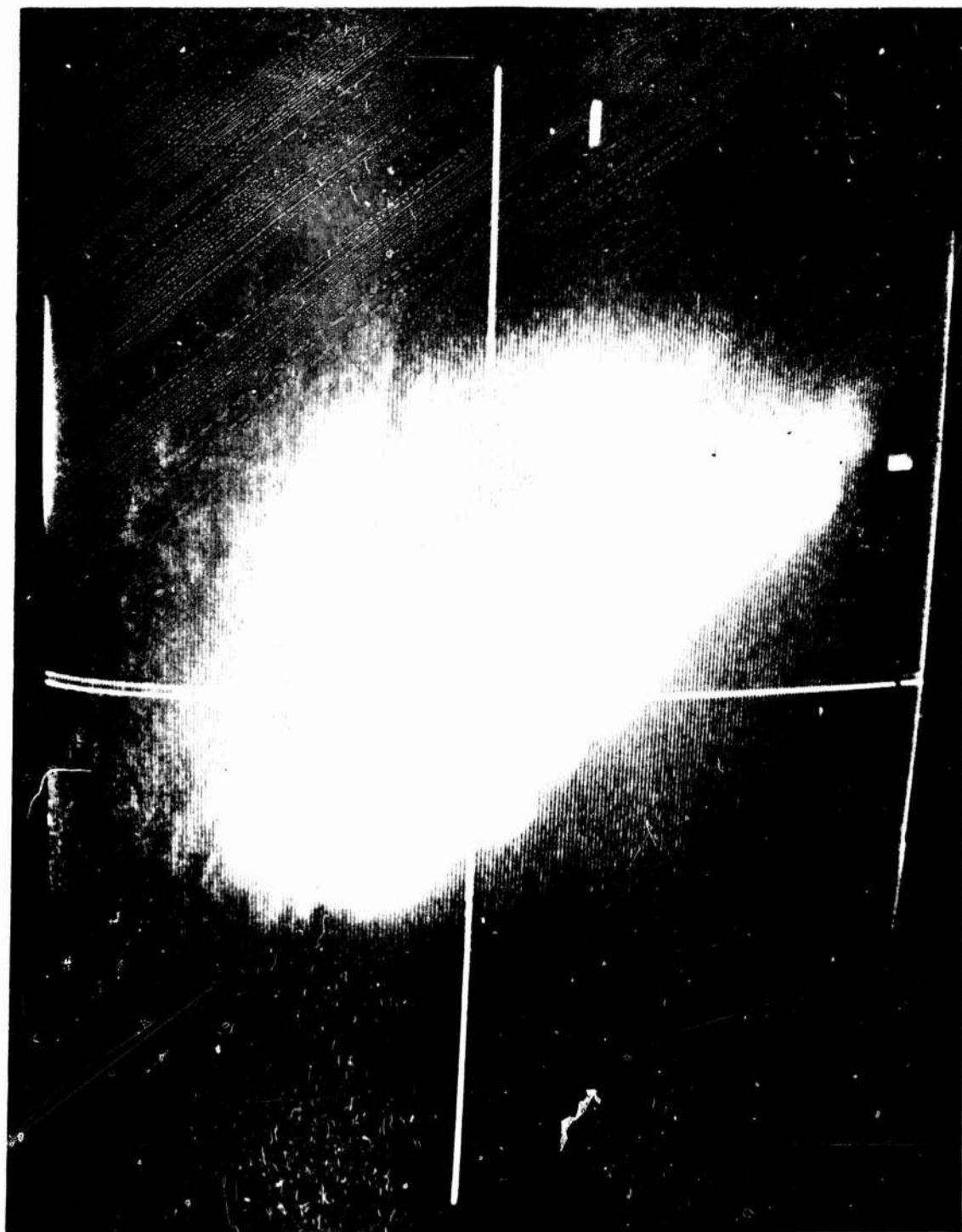


FIGURE 4-3. Wide Field of View Display Showing Searchlight Beam Width Limitation

f. The range of contrast adjustment available on the TV monitors was reported by some observers to be inadequate. Users suggested that artificially increasing the contrast ratio would enable better scene discrimination. This proposal was prompted by the washed-out appearance of the displayed scene that exists during especially low light level conditions.

35. (U) ADDITIONAL FACTORS AFFECTING OPERATORS

a. Pilots reported difficulty in retaining their night vision while scanning the RV. The primary cause of this problem was attributed to the red light source of the RV monitor and the glare that it cast on the windshield. However, light leaks around the red filter which reflected from shiny metallic surfaces (floor, cyclic stick) also contributed. This condition was especially noticeable on clear moonless nights. In an effort to remedy the situation, crews fabricated cardboard shields and taped up sources of light leaks (see Figure 4-2). A larger light shield on the monitor and an improved seal around the present filter are required. Investigation of filter colors and materials should be conducted in an effort to improve night vision retention without adverse effects on display quality.

b. DV operators reported eye fatigue usually occurred after 4 hours of operation. This sometimes resulted in headaches. Operators also experienced a temporary loss of night vision in one eye when using this system due to the unfiltered light of the phosphor. This could create a problem if the copilot was required to take control of the helicopter prior to regaining night vision in both eyes.

c. Use of the DV was hindered whenever a 1:1 vertical vibration occurred in the helicopter. This condition forced the operator to hold his eye farther from the DV eyepiece than normal. The resulting relative angular displacement between the operator's eye and the eyepiece then became very pronounced, preventing use of the DV in its narrowest field of view. In addition, vibration caused the operator to make erratic tracking control movements, further aggravating the situation. Limiting vibration through careful attention to rotor blade rigging was necessary at all times.

d. The focusing control rate on the DV was too slow. The focusing rate on the RV was slightly better. Focus must be changed frequently to accommodate for altitude variations and the rate-of-closure on a specific target as well as when searching new areas of interest. Operators found that focusing was most easily accomplished in the narrowest FOV. By so doing, this produced an apparent improvement in the focus of the wide FOV at the same range. To reduce the time required to focus either viewer, a fixed focus or possibly a two-position (near and far) focus might be used, providing depth of field is adequate in normal operating (detecting) ranges.

e. DV operators reported losing directional orientation on some occasions in spite of the fact that they were actually pointing the sensor with one hand. There is a need for indicators in the DV system to provide information showing the direction of scanning with respect to the helicopter. Markers visible to the copilot on the DV sight and to the pilot on his RV monitor should indicate the horizontal and vertical deflection in degrees. This feature will also assist the pilot since it will indicate where the copilot is looking when he detects a target, thereby improving communication between the operators.

f. The wing nuts (see Figure 4-4) used to secure the stray light visor to the turret heads frequently became lost during the change-over between neutral density filters and the visors. Non-captive devices such as wing nuts are easily lost under field operating conditions. The securing device for the visor should be similar in design to the attachment lug on the neutral density filter.



FIGURE 4-4. Non-captive Wing Nuts on Stray Light Visor

36. (U) CREW COORDINATION

Although previously cited as a problem area during the modified service test of INFANT, crew coordination was not judged to be a problem by crews operating in RVN. Lack of experience and crew drill were the most likely contributing factors to the earlier findings. It was clearly understood during the RVN evaluation that the pilot was responsible for providing separation from obstacles and other air traffic. This was considered an acceptable task in spite of the additional duties which the AN/ASQ-132 imposed on the pilot. Contrary to earlier findings, pilots reported the RV did provide some useful information relative to local area navigation or orientation, particularly when flying in a familiar area. Coupled with GCA guidance, the RV was of assistance in determining exact location when distinctive terrain features were available. The RV was always considered the pilot's system, while the copilot was the sole user of the DV. Crews indicated that single-sensor systems might produce a conflict in time-sharing. In general, INFANT crews expressed the strong feeling that the Army must stress teamwork along with a thorough understanding of the individual crew responsibilities associated with the sophisticated weapon systems being introduced into the aviation inventory. A crew task list compiled as a result of operational experience is provided at Appendix G.

37. (U) PILOT TRAINING REQUIREMENTS

a. An attempt was made to determine realistic prerequisites for INFANT aviators. Although it is desirable to have only the most qualified rotary wing aviators operating this expensive and sophisticated equipment, levels of prior experience considered essential and at the same time practical from a personnel availability viewpoint were established by the aviators participating in this evaluation. The INFANT pilot should have combat experience, preferably in the UH-1B,D or H utility helicopter and the UH-1C gunship. The UH-1 experience provides the aviator with proficiency in all aspects of rotary wing flying, while the gunship experience provides familiarization with the M21 Armament Subsystem. The INFANT pilot trainee should be skilled in night flying, although no minimum night flying requirement is defined. The Army tactical instrument qualification is sufficient, but the standard instrument qualification is preferred.

b. Based upon NET Team experience in training additional aviators during this evaluation, the prerequisites for an aviator entering night attack helicopter training are as follows:

- (1) Have a minimum of 200 hours combat flying, preferably in the AO in which he will operate
- (2) Possess tactical instrument qualification

- (3) Be UH-1 qualified
- (4) Have a general knowledge of the M21 Armament Subsystem
- (5) Have no inhibitions regarding night flying.

c. Training of INFANT aviators having the above prerequisites can be accomplished in a 3-week period, including 25 flight hours accompanied by ground school. A proposed program of instruction is provided in Appendix H.

d. Until such time as improved pilot information displays can be incorporated into the INFANT RV monitor, care must be exercised in pilot selection. Individual capabilities and limitations and an understanding of good instrument flying techniques must be stressed during training.

38. (U) TRAINING REQUIREMENTS FOR MAINTENANCE PERSONNEL

a. NET Team personnel who maintained the INFANTs during the evaluation were qualified in aircraft, armament, and electronic skills. Only the military occupational specialties (MOS) associated with maintenance of the AN/ASQ-132 require discussion. Personnel with the following MOSs participated in the evaluation of the maintenance test package: 26T40, Television Equipment Repair Supervisor; 26T20, Television Equipment Repairman; 35E20, Special Electrical Devices Repairman; 35L20, Avionic Communications Equipment Repairman; and 35M20, Avionic Navigation Equipment Repairman.

b. Training and experience of the electronics maintenance personnel prior to commencement of the evaluation was as follows:

(1) Three 26T repairmen had attended a 26-week Television Equipment Repair Course at Fort Monmouth, New Jersey. Previous field experience included 1 with 2½ years, 1 with 1 year and 1 with 3 months.

(2) One 35E repairman had attended a 13-week Special Electrical Devices Repair Course at Fort Belvoir, Virginia. This individual had 1 year of field experience.

(3) One 35L repairman had attended a 17-week Avionic Communication Equipment Repair Course at Fort Gordon, Georgia, and had 10 months experience in the field.

(4) One 35M repairman had attended a 17-week Avionic Navigation Equipment Repair Course at Fort Gordon, Georgia, and had 8 months experience in the field.

c. Additional training on maintenance of the AN/ASQ-132 subsystem was provided the three 26T repairmen and one 35E repairman at a

3-week INFANT operating and maintenance course at Hughes Aircraft Company, Los Angeles. All NETT personnel acquired 7 months experience with INFANT in CONUS prior to the evaluation in RVN. The 35L and 35M repairmen were trained in RVN during a 2-week period of classroom instruction conducted by a contractor field service representative. This was followed by 8 weeks of on-the-job training.

d. This training was purely an evaluation device to determine if any particular prerequisites for selection of AN/ASQ-132 repairmen existed. It was found that basic troubleshooting techniques taught in the previously mentioned service schools were a satisfactory foundation for further training in AN/ASQ-132 maintenance. Generally speaking, none of the maintenance personnel encountered situations that required any special techniques or skills beyond those which prior training had provided.

e. There are several observations worthy of note:

(1) As would be expected, individual scores in the general and specific aptitude areas normally were indicative of capabilities to perform maintenance on the AN/ASQ-132.

(2) The maintenance situations encountered with INFANT were not uniquely associated with any particular MCS skills.

(3) Those individuals who had a strong fundamental knowledge of electronics were best qualified to troubleshoot failures and understand their probable causes.

(4) Individuals with sound electronics backgrounds and minimal training on the AN/ASQ-132 equipment became satisfactory repairmen.

(5) Mechanical aptitude was advantageous to AN/ASQ-132 repairmen.

f. A program of instruction for maintenance personnel is provided at Appendix I.

39. (U) OPERATORS' COMMENTS

The INFANT system requires improvements in order to be considered a well-designed system from a human factors point of view. In spite of the shortcomings noted, INFANT crews did not feel the system presented "an extremely dangerous flight situation," as previously reported in service testing. Operators were receptive to the idea of utilizing this concept for a night attack helicopter. They acknowledged a requirement for instrument flying proficiency, noting that "most night flying in RVN really demands the same skills, but INFANT makes you more aware of it." INFANT pilots stated that it would not be possible to fly the helicopter by referring only to the RV display; it does not provide sufficient

information because of its lack of depth perception and limited field of view. In this respect, they excluded its use as a primary aid to landing, position keeping, or for any other use requiring depth perception. However, for night surveillance, target acquisition, and fire control they thought it was well suited. There was general disfavor of the DV subsystem, and most pilots indicated a preference for use of two RV subsystems. Results of a human factors questionnaire appear at Appendix J.

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SECTION V

OBJECTIVE 4 - EMPLOYMENT

40. (C) FLIGHT ENVELOPE

Loading procedures followed during the evaluation did not permit the UH-1M to exceed the prescribed maximum allowable gross weight of 9,500 pounds. The added installed weight of the AN/ASQ-132, 664 pounds, and its distribution required constant attention to helicopter loading. The crew consisted of four members: pilot, copilot/gunner, crew chief/door gunner, and door gunner. The crew chief and door gunner were armed with M60 machine guns and carried a basic load of 450 rounds per weapon. The M21 Armament Subsystem carried a normal load of 14 2.75-inch FFAR and a reduced load of 4,500 rounds of 7.62mm minigun ammunition. The maximum fuel load that could be safely carried was 1,200 pounds. This allowed a 1 hour and 30 minute sortie time with a 30-minute fuel reserve. With normal personal equipment and survival gear, the total weight reached 9,500 pounds, the maximum allowable. Normal en route airspeed from the base of operations to a mission area of operation (AO) was 75-80 knots. Airspeed on-station in an AO was normally reduced to 60-70 knots. Operational altitudes on missions varied from 600 to 1500 feet AGL, depending upon ambient light conditions, i.e., moonlight, starlight, or overcast sky. The most frequently used altitudes were between 600 and 800 feet AGL; these gave the best overall picture quality and search capability under normally encountered light conditions.

41. (U) OPERATING PROCEDURE

a. The number of INFANT systems available was reported to the aviation battalion S3 each morning following daily post-mission inspection. Normal PM by maintenance crews (technicians and crew chiefs) usually resulted in operationally ready systems by 1500 hours, at which time pilots conducted the preflight inspection. This included an engine run-up and a complete checkout of the AN/ASQ-132 and armament subsystems to ensure mission readiness. INFANT missions normally were received by the company operations officer between 1700 and 1800 hours. He then prepared a mission information sheet for the designated crewmembers. Data on this sheet included the current weather, forecast weather, winds aloft, moon phase, supported unit landing zone, radio frequency, and time of briefing at the supported unit. A remarks section on the form was used for additional comments that might affect the mission. Company mission briefings were normally held 50 minutes prior to take-off time. At this time, crews received the SOI, and were given an emergency UHF radio and survival gear. The crew that was to fly the chase helicopter (explained in Paragraph 42 below) was also briefed at this time. Pilots normally arrived at the INFANT 35 minutes prior to take-off. This provided an opportunity to recheck the helicopter and insure that the armament subsystem was operationally ready (properly loaded). The engine was started 5 minutes prior to take-off and the system was checked again to ensure that everything

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was in good working order. A crew of INFANT technicians was kept on standby alert in the event of system malfunction. The pilot's take-off time was selected so that he arrived at his destination (TOC of supported unit) approximately 20 minutes early, in order to refuel prior to the unit briefing.

b. The unit briefing was normally conducted by the S3 (generally at brigade level). He assigned "boxes" (grid squares) to be searched to the INFANT crew and specified whether or not they were SSZ. Radio frequencies of the ground units to be supported were also given out at this time. The S2 normally followed the S3 with an intelligence briefing. He usually covered topics such as the enemy activity in his tactical area, enemy movement, reported ground-to-air fire, and possible enemy camps and supply routes. INFANT crews were instructed in the role they would play in searching particular areas and what information the supported unit hoped to obtain from the mission. The coordinates of the boxes to be searched were provided to the artillery LO and to the GCA operator (when GCA was available). The artillery LO then obtained clearances for the flight to the mission AO. The GCA operator plotted the assigned areas on his scope for use in vectoring INFANT to the mission AO and for keeping the helicopter within the confines of the established search areas.

c. Following the completed missions or sorties, the INFANT crew provided all information obtained to the supported unit. This included areas and boxes actually covered, targets, coordinates, weapons used and rounds expended, and the results of any engagements. Mission release was normally obtained at this time from the supported unit. The INFANT crew reported these same mission data to the aviation battalion S3 upon return to the base airfield. Mission time varied from 4 to 5 hours per night during the evaluation (see Mission Profile, Appendix F).

42. (C) TYPICAL EQUIPMENT CONFIGURATION AND MIXES

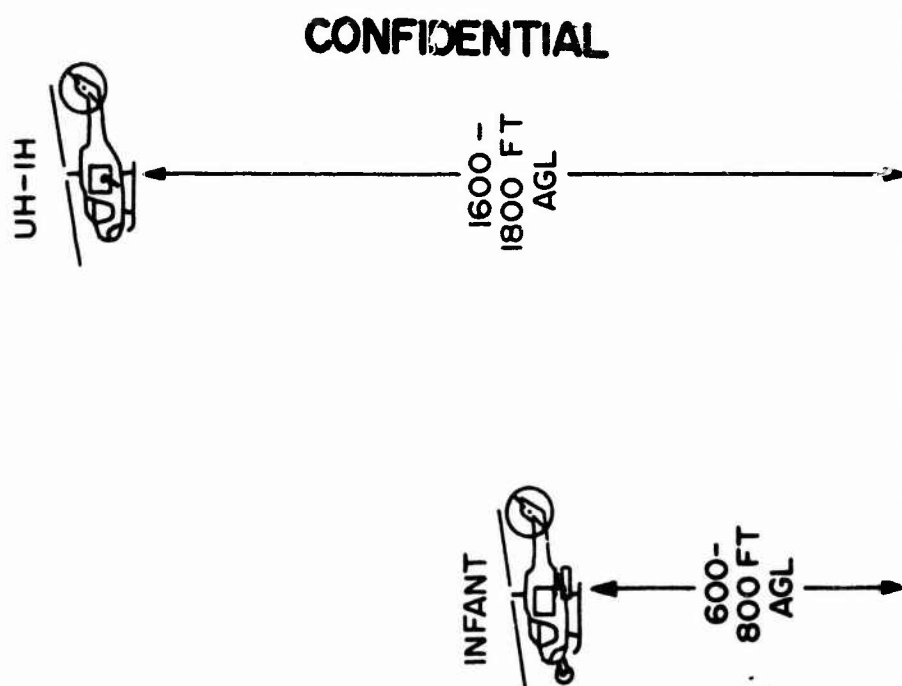
Various combinations of aviation resources were involved in the conduct of missions. Generally speaking, these were subject to the availability of equipment, the interest of the using organization in employing INFANT, knowledge of its capabilities, and the imagination of the individuals involved in planning operations.

a. INFANT and one UH-1H equipped with one door-mounted .50 cal machine gun. The UH-1H was used as a cover aircraft normally flying 1,000 feet above, slightly to the right of and approximately 1 km in trail of INFANT (see Figure 5-1). This technique and equipment combination was used most often during the evaluation.

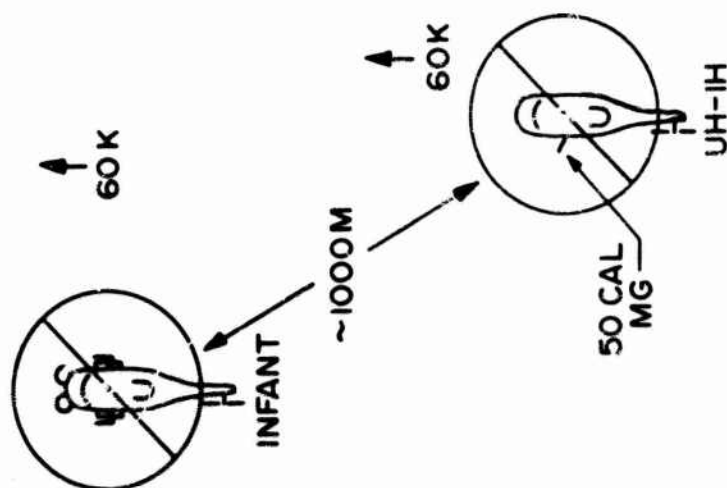
(1) Advantages

(a) The UH-1H has the capability of being utilized as a command and control (C&C) aircraft.

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FIGURE 5-1. (C) INFANT and UH-1H (.50 Cal MG) (U)

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(b) The UH-1H can provide additional firepower (.50 cal mg) at a greater standoff distance against enemy weapons of equal caliber.

(c) The UH-1H serves as an additional observation platform for ground-to-air fire and is capable of delivering neutralizing fire when required.

(2) Disadvantages

(a) The UH-1H in this configuration can only provide effective protective fire from one side of the helicopter.

(b) The UH-1H can provide only limited (dependent upon crew size and ammunition load) recovery capability for the INFANT crew in the event of distress.

b. INFANT and one Night Hawk (for description, see Paragraph 6, reference 1k) equipped UH-1H. Night Hawk was used numerous times in operations with INFANT. The Night Hawk was usually configured with illuminating flares, xenon searchlight (IR/white light), night observation device, and a door-mounted minigun. Its position and role relative to INFANT were normally the same as described in Paragraph 42a above (see Figure 5-2).

(1) Advantages

(a) Night Hawk can be used as a C&C aircraft.

(b) Night Hawk can drop flares to provide additional light under low ambient light conditions. The flare was normally dropped at a considerable offset distance (2-5 km) from the INFANT, thereby serving as a decoy and not silhouetting the INFANT.

(c) The Night Hawk searchlight improved BDA capability.

(d) The Night Hawk minigun added firepower.

(e) Night Hawk provided illumination for recovery aircraft.

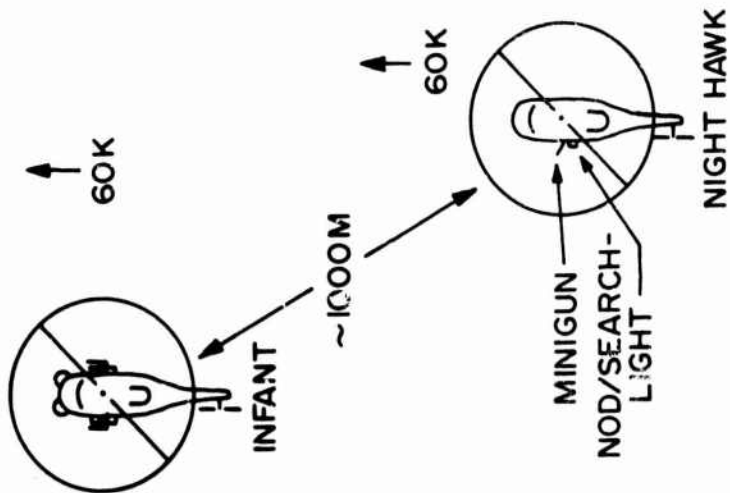
(2) Disadvantages

(a) Standoff capability of minigun against larger caliber ground-to-air weapons (i.e., .51 cal mg) is limited.

(b) Night Hawk is taken away from its normal nighttime mission, and is not used as effectively as when it operates by itself.

(c) Recovery capability of Night Hawk is limited due

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1600 -
1800 FT
AGL



600 -
800 FT
AGL

FIGURE 5-2. (C) INFANT and Night Hawk (U)

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to its mission equipment and crew size. A twin Night Hawk configured UH-1H would have no recovery capability.

c. INFANT, AH-1G Hueycobra, and one UH-1H. This configuration was employed numerous times and found to be very effective. The AH-1G flew 1000 feet above INFANT in an orbital pattern providing continuous air cover. The UH-1H was used as C&C at an altitude of 1500 feet above INFANT to provide maximum control of the two other aircraft (see Figure 5-3).

(1) Advantages

(a) Additional firepower and standoff capability are provided by the AH-1G.

(b) UH-1H provides positive control of the other aircraft from a safe altitude, thereby permitting the AH-1G and INFANT crews to concentrate on the enemy situation.

(c) AH-1G provides improved capability to detect ground-to-air fire in all quadrants and provide immediate neutralizing fire.

(d) UH-1H can serve as recovery aircraft for AH-1G or INFANT.

(e) Maximum capabilities of all aircraft are exploited.

(2) Disadvantages None were apparent.

d. INFANT and UH-1H equipped with one .50 cal mg. UH-1C(A) gunship. In this configuration, INFANT and the UH-1H were lead aircraft with the UH-1C(A) gunship in trail providing cover and added firepower when required. The UH-1H was middle aircraft in altitude, flying 1000 feet above INFANT. The UH-1C(A) was "high bird" at 1500 feet above INFANT (see Figure 5-4).

(1) Advantages

(a) The UH-1H with .50 cal mg provided standoff capability against enemy ground-to-air weapons.

(b) UH-1C(A) gunship added firepower.

(c) Two aircraft provided cover for the "low bird," INFANT.

(2) Disadvantages

(a) There is a potential control problem when one target is engaged by all three aircraft.

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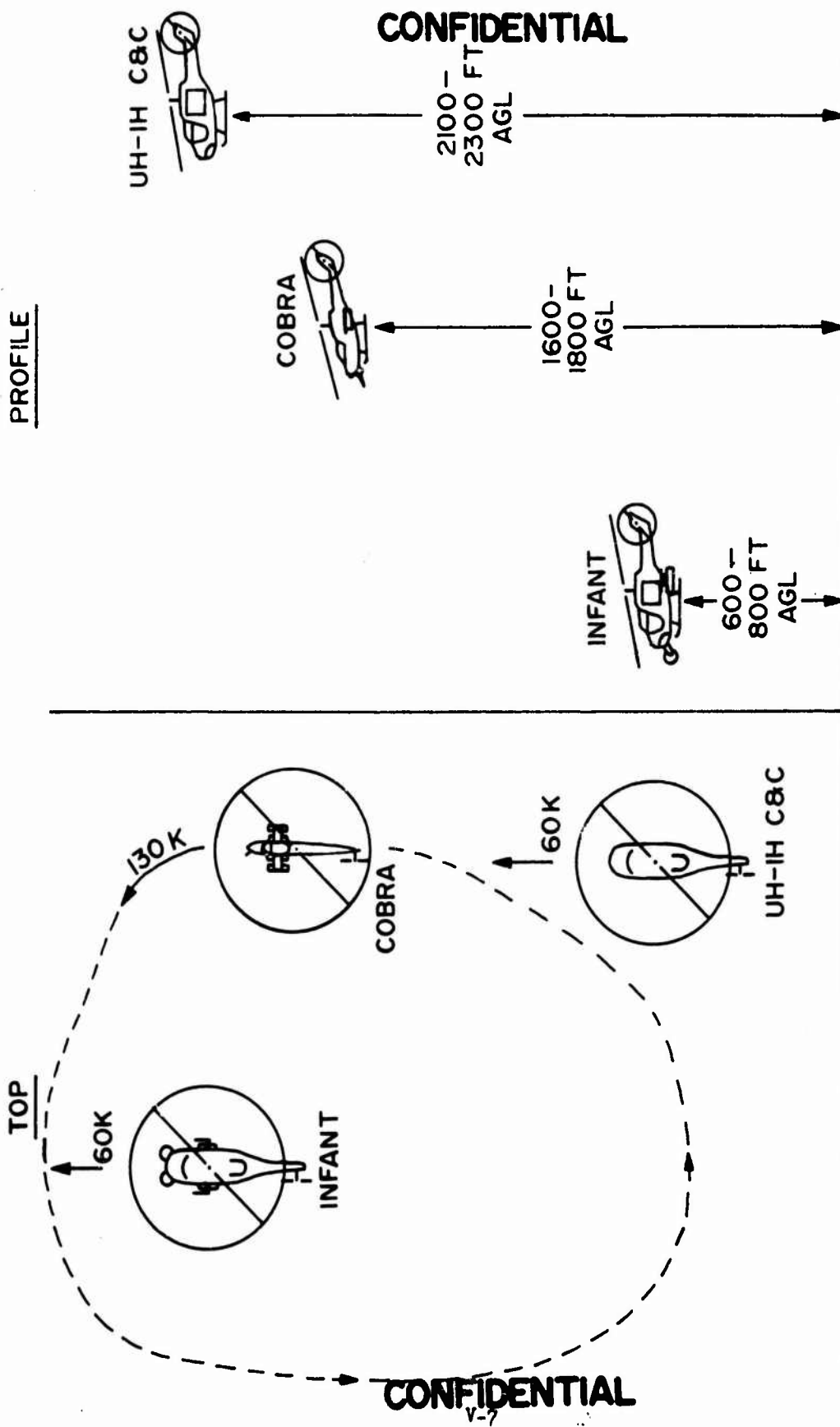


FIGURE 5-3. (C) INFANT, Hueycobra and UH-1H C&C (U)

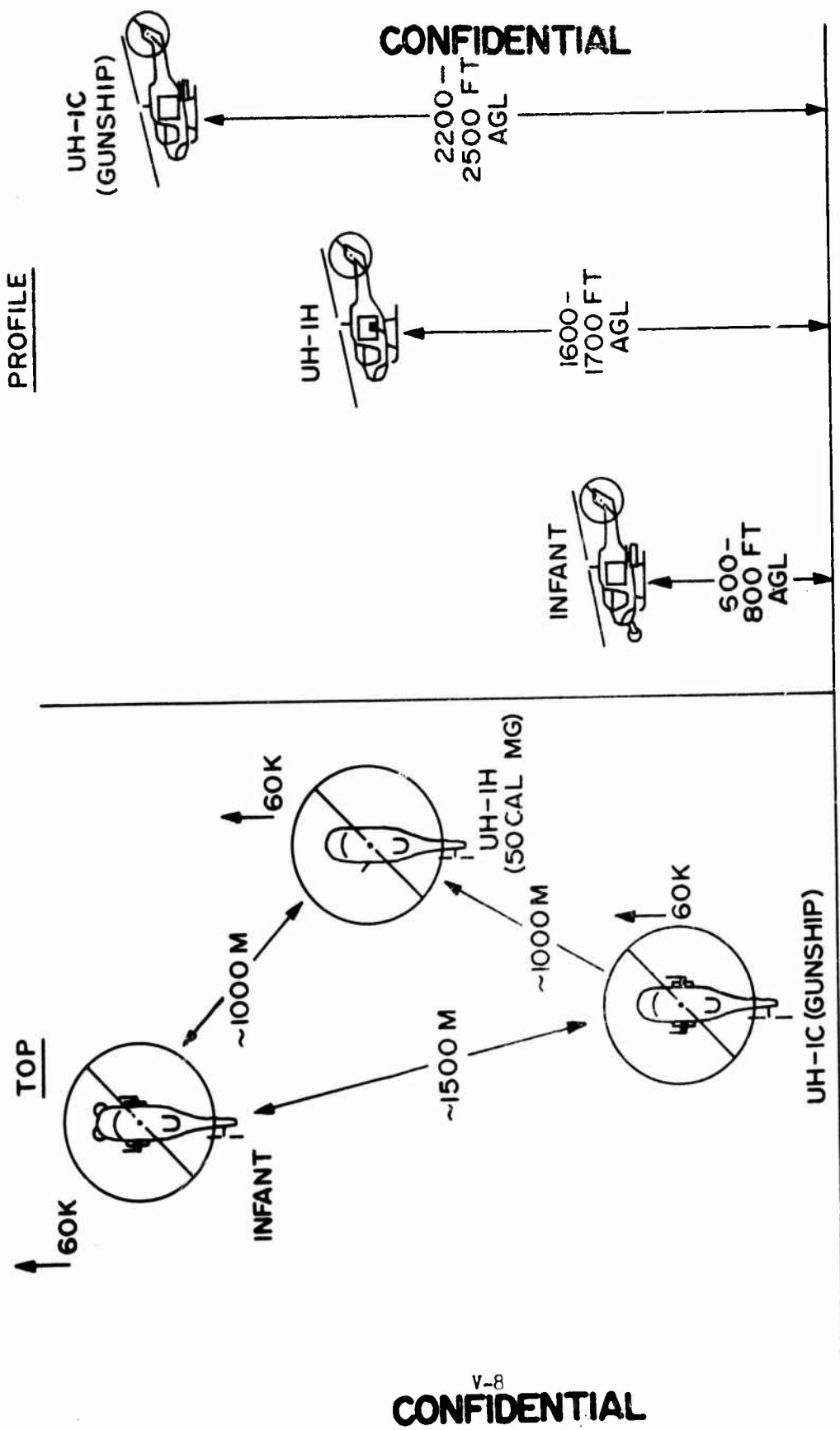


FIGURE 5-4. (C) INFANT, UH-1H (.50 Cal MG) and UH-1C(A) gunship (U)

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(b) Both UH-1H and UH-1C(A) have limited recovery capability.

e. Two INFANTS and one UH-1H C&C. Two INFANTS were employed at normal operating altitude with the second INFANT in echelon 400 feet above and approximately 2 km behind the lead INFANT. The trail INFANT scanned an area 500-1000 meters left or right of the lead INFANT and provided covering fire when needed. The UH-1H flying 1500 feet above the INFANT fire team provided C&C and recovery support (see Figure 5-5).

(1) Advantages

(a) Two INFANTS are capable of scanning a larger area in a single pass.

(b) UH-1H configuration is better suited for recovery.

(c) Additional compatible (dim tracer) firepower is provided by the second INFANT.

(2) Disadvantages

(a) UH-1H does not have capability of providing neutralizing fires or cover for low flying INFANTS.

(b) There is a potential control problem if two INFANTS become widely separated.

(c) Restriction is placed on trail pilot's use of the INFANT RV, as he must maintain orientation of the lead INFANT.

f. Two INFANTS, one AH-1G Hueycobra, and one UH-1H C&C in conjunction with one OV-1B or C Mohawk (Night Phantom Operation). The two INFANTS, one AH-1G, one UH-1H C&C, and one Mohawk were employed as a task force. The Mohawk was used to acquire potential targets for investigation by INFANT. The lead INFANT flew at 600 feet AGL with the trail INFANT at 1000 feet. Again, the trail INFANT normally flew in echelon formation, 2 km behind, scanning an area 500-1000 meters left or right of the lead INFANT. This was judged the widest separation possible for coordinated fire team operations. The AH-1G normally flew 600-1000 feet above the INFANTS in an orbital pattern around both lower aircraft. The UH-1H was used as mission C&C operating 1100-1500 feet above the two INFANTS below (see Figure 5-6). See Appendix K. This configuration was judged most effective in economy of effort and potential results.

(1) Advantages

(a) INFANT aircraft, when used as a fire team, are able to scan a larger area on a single pass.

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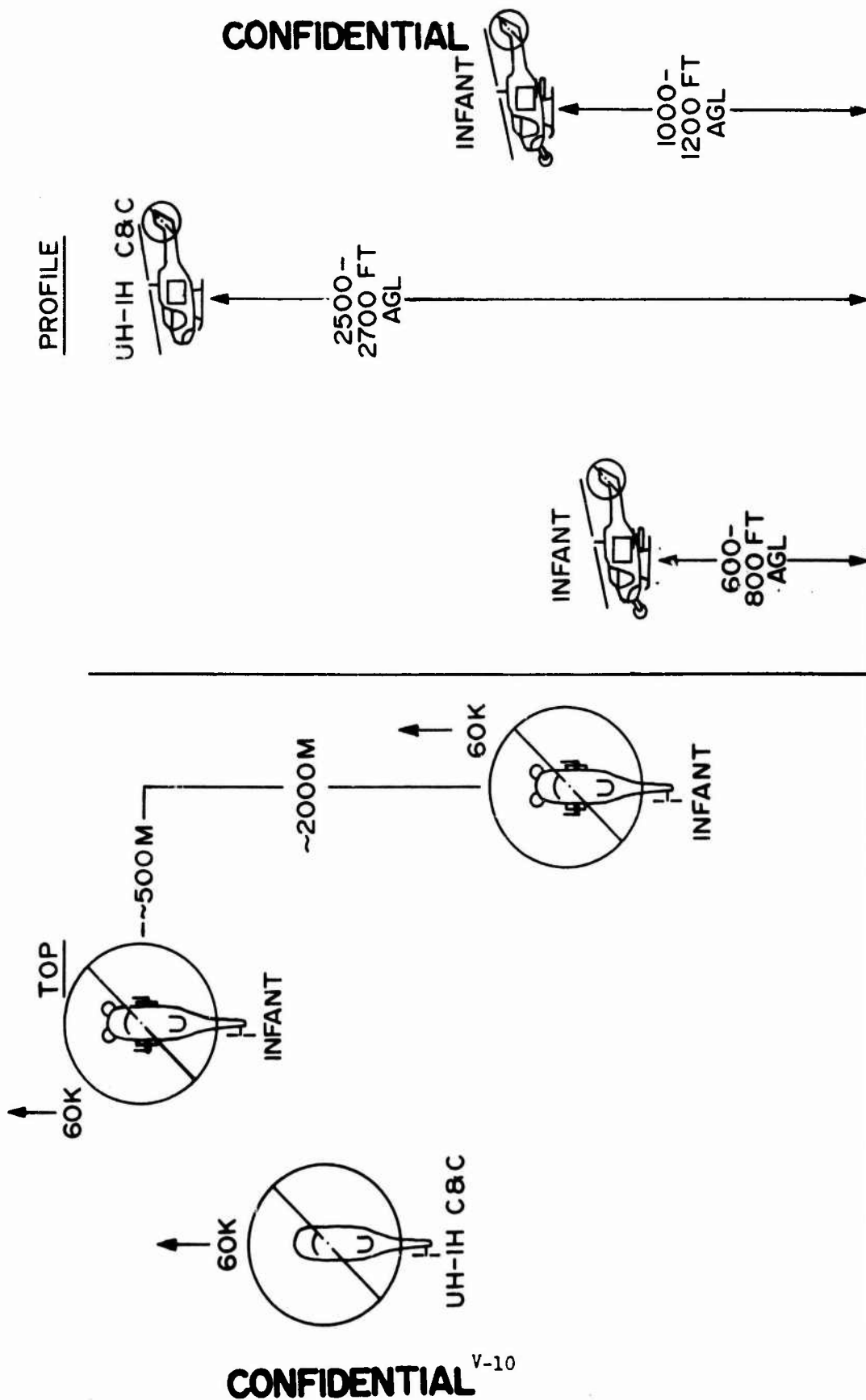


FIGURE 5-5. (C) Two INFANTS and UH-1H C&C (U)

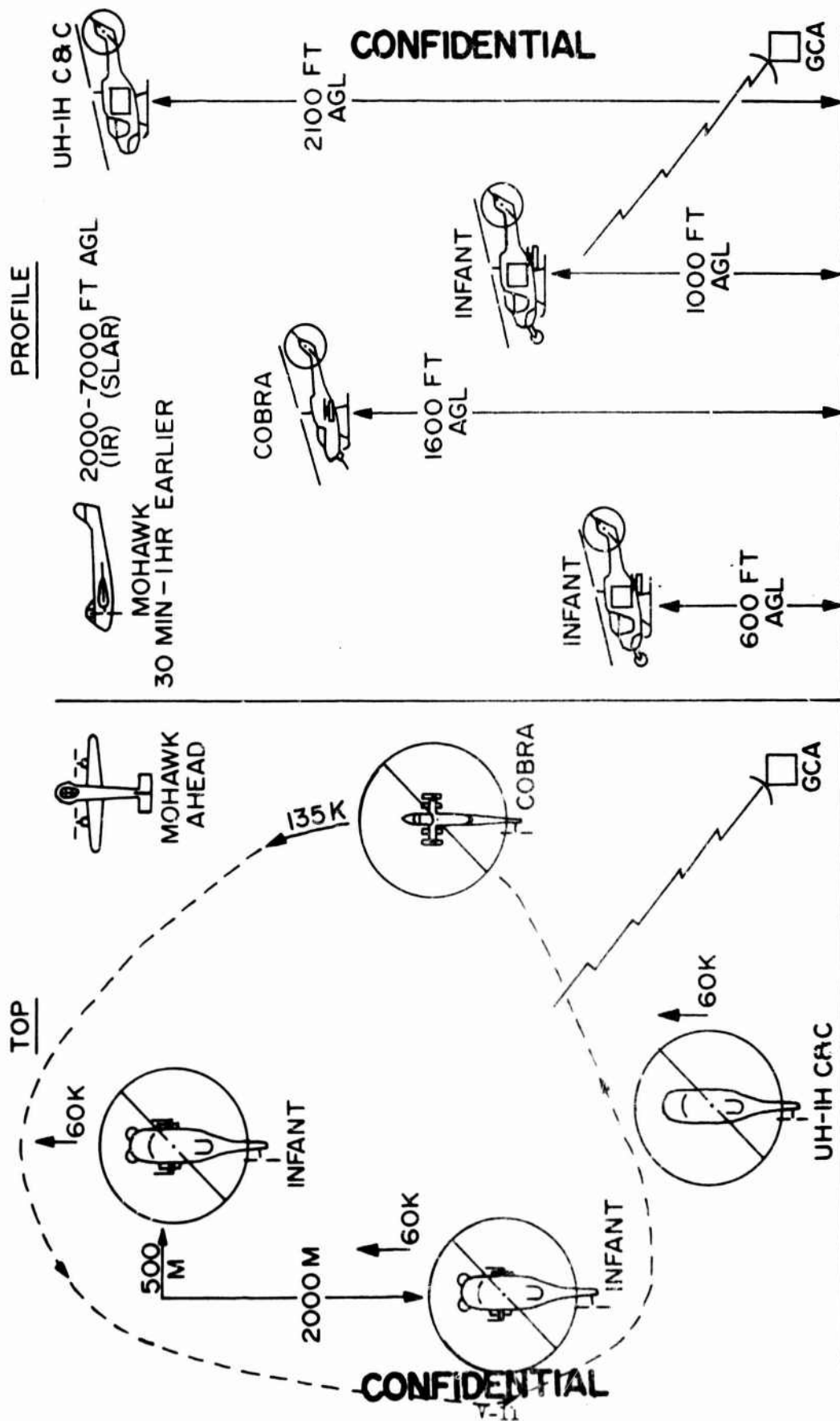


FIGURE 5-6. (c) INFANT Night Phantom Operation (U)

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(b) AH-1G provides improved capability to detect ground-to-air fire in all quadrants and provide immediate return of neutralizing fire.

(c) UH-1H provides C&C and recovery capability.

(d) Mohawk has capability of covering a large area, permitting gunships to remain on standby alert, thereby minimizing usage of other aircraft.

(e) Mohawk optimizes INFANT's local area target acquisition and fire control capability, particularly on moving targets, by monitoring movement and directing INFANT to the target area through GCA radar.

(2) Disadvantages

(a) Restriction is placed on trail pilot's use of the INFANT RV, as he must maintain orientation on the lead INFANT.

(b) UH-1H C&C experiences difficulty in controlling several widely separated aircraft.

(c) GCA assistance is required in vectoring gunships to potential target areas detected by Mohawk.

43. (C) METHOD OF SEARCH

For maximum area coverage, the pilot normally searched the area 500 to 1000 meters ahead of the helicopter. This was determined to be the best technique as it allowed the pilot time to align the helicopter for a rocket run whenever a target was detected at sufficient range to permit a first-run attack. The copilot normally searched an area from approximately 100 to 500 meters in front of and to each side of the helicopter. This permitted engagement with the miniguns and also provided the opportunity to engage targets detected too late to be engaged by rockets. In general, the DV and RV subsystems were operated independently, although the slaving feature (RV in M6 mode) was used on occasion by the copilot/gunner to convey target location to the pilot.

44. (C) EFFECTS OF TERRAIN, WEATHER, ENEMY THREAT ON EMPLOYMENT

a. Terrain. When flying over canopy, some operators preferred to fly higher than normal in order to look down into openings. This was attributed to line-of-sight visibility limitations and normally resulted in use of miniguns only. Rockets were employed whenever a light source was spotted through the canopy. INFANT was able to detect partially hidden light sources that the unaided night adapted eye could not detect.

b. Weather. Under conditions of low ceilings, the chase aircraft

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was limited in altitude separation for adequate safety. This was in part attributed to the weakness of the INFANT formation lights, to be discussed later. Low ceilings generally meant lower and more vulnerable operating altitudes for INFANT. This is primarily due to the limitations of the sensors under very low ambient light levels. Their general lack of terrain and obstacle avoidance capability also made low level operations more hazardous. This was previously mentioned in Paragraph 19 and is also further discussed under human factors. Limited visibility conditions (less than 3 miles) were not encountered during the evaluation.

c. Enemy Threat. Techniques of employment were not significantly affected by enemy threat any more than in the case of any other weapon system.

45. (C) EFFECTS OF SYSTEM LIMITATIONS ON EMPLOYMENT TECHNIQUES

The three most significant limitations influencing employment during the evaluation were excessive light, position determination, and line of sight detection.

a. Excessive Light. It was found that operations conducted where fires were burning or in close proximity to perimeter lighting had limited results because the bright light normally caused the protective shutter to close, discontinuing further image display. Near such light sources it was also more difficult to detect campfires that might otherwise be observed. This is attributed to the automatic light control (ALC) of the system which effectively cuts down admitted light. Perimeter reconnaissance was normally flown at distances from the nearest light source greater than 500 meters.

b. Positive Position Location. During missions conducted under very low light conditions or over wide expanses of heavy foliage, it was necessary to use GCA radar, when available, for positive position location. This was essential when operating in close proximity to positions of friendly forces, when near national borders, and whenever there was an absence of prominent terrain features. Once they were within the AO, the crew used the AN/ASQ-132 for local navigation and orientation. However, the AN/ASQ-132 does not function as a cross-country navigation aid, except when flying along a distinct feature such as a road or river.

c. Line of Sight. The AN/ASQ-132 depends upon reflected light or light emitted from a target to produce an image display. As a result, targets hidden from the viewer by any obstacle cannot be detected. This accounts in large measure for the relative ineffectiveness of INFANT over canopied areas.

d. Detection Range. INFANT crews indicated that greater detection ranges would have resulted in increased use of rockets when engaging targets. They reported difficulty in acquiring targets soon enough to establish optimum flight trajectories for rocket firing runs. The primary limita-

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tions to effective rocket firing were insufficient altitude above ground and limited slant range to target. The latter reduces the number of accurately aimed sequentially fired rockets possible in a single target run.

46. (C) VARIATION FROM DAY ATTACK HELICOPTER OPERATIONS

a. In order to utilize INFANT to its fullest capability, tactics normally employed by gunships during daylight hours were altered for INFANT application. The variations required in INFANT tactics are largely attributed to its semi-covert nature and sensor limitations.

b. The first variation in normal gunship practice is the operating altitude. Normally gunships operate at or above 1500 feet AGL or at low level "nap-of-the-earth" altitudes. INFANT systems normally fly between 600 and 800 feet AGL, since the best picture quality is achieved at this altitude, thereby enhancing probability of target detection. Because INFANT has the capability of flying "black-out" using the special formation lights described earlier, a certain degree of safety from ground-to-air fire is provided. No hits from ground-to-air fire were encountered during the evaluation period. Nap-of-the-earth flying is not possible at night, as the AN/ASQ-132 does not provide terrain avoidance capability. The reasons for this are noted above in the discussion of capabilities (Paragraph 19).

c. Normally attack helicopters break off their firing runs before reaching the targets. However, since INFANT target detection occurs at relatively close ranges (500-700 meters), overflight of the target became a frequent occurrence. This was avoided whenever possible, although overflight usually occurred during an initial pass on target. The blacked out configuration appeared to reduce vulnerability during overflight. However, overflight was avoided on subsequent gun runs after a target was located and identified. Crews reported that the most noticeable difference between INFANT and normal gunship operations was that INFANT was actually searching for targets (armed reconnaissance), while gunships more frequently attacked targets discovered by some other means.

47. (C) WEAPON CONSIDERATIONS

a. A disadvantage of the dim tracer and flash suppressor used on INFANT was that, in addition to the enemy not being able to see the weapon being fired, the accompanying support aircraft could not observe the fire either. Rocket firing afforded a limited target designation capability, although it was never used solely for that purpose.

b. When engaging targets with rockets having M151 10-pound HE warheads, difficulty was encountered in determining point of impact. This problem arose due to the blooming effect on the video monitor from the bright point light source. As a result, only the probable impact area could be determined based upon the rocket's observed flight path prior to

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impact. In addition, most pilots felt that achieving accuracy in night firing was difficult because of normal distractions present at night. In view of the above, the pilots expressed strong preference for use of the flechette warhead instead of HE. Since fortified positions were rarely engaged, use of the flechette seems warranted. The flechette's greater lethality for personnel standing in open terrain when compared to the M151, 9953 sq. ft. vs. 3638 sq ft., appears to support this preference. The limited rocket payload of the M21 subsystem also tends to support the choice of the flechette over the HE warhead, especially in effectiveness against enemy troop movement at night. High success in neutralizing targets when employing flechette warheads was reported.

42. (C) LESSONS LEARNED

As is to be expected with the introduction of new equipment into a combat situation, conservative use of the new item and a general lack of understanding of its capabilities and limitations will exist. Some of the problems encountered with INFANT are enumerated below.

a. The most common problems encountered during this evaluation stemmed from the fact that the units supported had little or no knowledge about the INFANT system and its capabilities and limitations. This frequently resulted in poor utilization of the system during a mission, e.g., sending it into an area to conduct perimeter search, where its capability was limited by bright lights.

b. Use of the INFANT over triple canopy jungle instead of areas such as roads, rivers, and trails was also unprofitable. All supported units were given a briefing and demonstration of the INFANT system. However, in several instances, key personnel (i.e., the S2, S3, G2, G3, etc.) were not available for demonstrations, nor did they show interest at any other time. Numerous repeat demonstrations and briefings were given by the INFANT NETT to point out the system's limitations and capabilities. Most of these were held immediately prior to missions; consequently, they did not enhance mission performance because mission planning usually preceded these familiarization briefings. Subsequent mission assignments rarely produced more effective utilization by these same supported units.

c. Another problem encountered was establishing radio contact with the ground troops having responsibility for the area within designated specified strike zones. Although INFANT could receive and transmit on the radio frequencies of the ground units involved, frequently these units would be using their voice secure equipment, which INFANT did not have. In this situation, it usually took 30 minutes to establish contact before the mission could be effectively accomplished. This was particularly detrimental, since the aircraft is limited to 1½ hours flight time between refuelings.

d. The distance from the supported unit's base to the mission AO was, on occasion, unrealistic. In one such instance, INFANT boxes

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were located 44 km from the operating base and refueling area. This limited time-on-station to only 50 minutes. Therefore, the majority of the flying time that night was spent as en route time. On another occasion, employment as proposed would have resulted in only 20 minutes of time-on-station. In this case, the INFANT crew convinced the ground commander not to conduct the mission, as the use of INFANT was not critical to it.

e. Even though artillery units were provided information early each night showing operational areas, they were slow in processing clearances into these areas or from one area to another. This frequently resulted either in non-productive time spent in orbit or operation of the helicopter on the ground while awaiting a clearance. On one occasion, artillery was fired into the INFANT operating area without notification from the artillery advisor. This resulted in rounds impacting so close to INFANT that the concussions were felt. On one other occasion, and unknown to the pilots at the time, artillery was being fired over a corner of the box in which INFANT was operating. One round passed close enough to the aircraft to activate the proximity fuse, which caused an air burst only 50 meters away. Fortunately no injuries or damage resulted.

f. In general, operators were disappointed with the employment of INFANT by ground commanders. Repetitious use over heavy jungle canopy was the primary contributing factor for this adverse comment from crews. They felt the INFANT was more appropriately used when employed over open terrain and waterways. Their overall opinion was that the system proved capable of detecting targets that could not be seen by the unaided, dark adapted eye. Chase aircraft crews flying missions with INFANT often made comments indicating that they did not see targets that INFANT discovered.

49. (C) EMPLOYMENT QUESTIONNAIRE RESULTS

The following is a summary of the responses to an employment techniques questionnaire. These responses by INFANT operators are based upon their knowledge of the techniques employed during 112 INFANT missions (192 sorties).

a. Total number of aircraft employed per mission (including other-than-INFANT aircraft).

One Aircraft - 5 missions

Two Aircraft - 101 missions

Three Aircraft - 3 missions

Four Aircraft - 2 missions

Five Aircraft - 1 mission.

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b. Did the disposition of friendly or enemy troops influence the technique of employment?

16 Yes - 15.4% of responses

88 No - 84.6% of responses.

c. Did the terrain influence the technique of employment?

13 Yes - 12.6% of responses

90 No - 87.4% of responses.

d. Did wind or weather conditions in AO influence technique of employment?

16 Yes - 15.2% of responses

89 No - 84.8% of responses.

e. Was enemy fire directed at the aircraft during mission?

23 Yes - 22.1% of responses

81 No - 77.9% of responses.

(No hits were reported--excluding the possibility that enemy ground fire may have caused the loss of A/C #66-0726.)

f. Could this mission have been accomplished by a helicopter without night vision capability?

3 Yes - 2.9% of responses

100 No - 97.1% of responses.

g. Was the night vision capability used as an aid to navigation and position location?

40 Yes - 38.1% of responses

65 No - 61.9% of responses.

h. Was the AN/ASQ-132 equipped aircraft used to assist other aircraft in navigating during formation flight or cross-country movement?

8 Yes - 8.2% of responses

90 No - 91.8% of responses.

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i. Was a mission or a sortie aborted?

44 Yes - 39.3% of responses

68 No - 60.7% of responses.

j. Reasons for mission/sortie aborts.

<u>REASON</u>	<u>NO. OF ABORTS</u>	<u>PERCENT OF ABORTS</u>
Weather	3	6.8
Enemy Situation	0	0
Aircraft Malfunction	10	22.8
AN/ASQ-132 Malfunction	7	15.9
Weapons Malfunction	7	15.9
Mission Coordination & Planning	6	13.6
Cover Aircraft Abort	6	13.6
GCA Limitation	4	9.1
Other	$\frac{1}{44}$	$\frac{2.3}{100.0\%}$

Per Cent of Missions Aborted (All reasons) $44/112 = 39.3\%$

Per Cent of Missions Aborted (AN/ASQ-132) $7/112 = 6.2\%$

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SECTION VI

OBJECTIVE 5 - EFFECTIVENESS OF FORMATION LIGHTS

50. (U) GENERAL

It was the unanimous opinion of all INFANT, chase, and support aircraft crews that there is an essential requirement for ground secure (not visible from below) lighting on night attack helicopters. Except as noted below, night formation lights permit another aircraft flying at a higher altitude to keep INFANT under surveillance and aided in station keeping. When participating as part of a fire team, the light aided the chase aircraft in maintaining visual contact with INFANT during some operations when the normal navigation lights were extinguished.

51. (U) CAPABILITIES AND LIMITATIONS

a. The Formation Light (540 Rotor System), P/N 204-3033-1, had some shortcomings that hindered its all-around use (see Figure 1-10). Due to the limited intensity of the electroluminescent (EL) panels, INFANT was forced to use its rotating beacon to assist support aircraft in maintaining visual contact. This occurred often when the second aircraft was separated from INFANT by more than 500 feet. Use of the rotating beacon or masked standard navigation lights frequently drew ground-to-air-fire. When the navigation or beacon lights were extinguished, enemy fire usually ceased; however, neither the enemy nor other aircraft could then see INFANT. Pilots suggested the elimination of the two lowest intensity level settings (five intensity levels are provided) on both the rotor tip and fuselage lights and the addition of two brighter positions. They also suggested enlarging the surface area of each EL panel to provide increased visibility at the greater distances involved in gunship tactics. If the light intensity of the present panels were to be increased appreciably, there is the possibility this would create light reflections off the helicopter rotor components. If so, the brightest settings would be usable only at relatively high altitudes above the ground, while the low settings (equivalent to present #3 to #5 positions) could be used when operating in close proximity to enemy forces. The present #1 and #2 positions are too dim and totally unusable. In general, visual contact with formation lights is required at relatively greater distances in gunship use than in utility aircraft applications.

b. A second shortcoming in employing formation lights on a gunship was apparent during rocket firing runs as soon as the helicopter entered a dive. This caused the rotor tip lights to become clearly visible to the enemy being engaged. Since the rotor tip and fuselage EL lights are controlled by two separate switches, the rotor tip lights were extinguished prior to a rocket run. This action requires the pilot or copilot to remember to extinguish the rotor light at a time when their complete attention should be directed to target engagement and flying the helicopter. Extinguishing of the rotor light should be

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activated automatically by the INFANT "Boresight" switch to relieve the pilot of this additional burden. Likewise, upon completion of the rocket run, when the "Operate" switch is activated, the tip lights should be automatically illuminated. Manual on-off capability should be retained for use in cases other than rocket runs when it is desirable to extinguish only the rotor tip lights.

52. (U) RELIABILITY & MAINTAINABILITY

a. During the evaluation period, one failure was encountered in the lighting systems installed in two INFANT helicopters. An apparent short circuit occurred in the rotor light component. Efforts to correct the failure were unsuccessful.

b. An uncorrectable 1:1 vertical vibration occurred in one INFANT helicopter. This is believed to have been caused from water seeping into the hollow blade at the point where the rotor tip light wiring enters the blade root (see Figure 6-1). The sealant between the plate and the end of the blade appeared either to have been applied improperly or to be ineffective in preventing water entry, since inspection inside the rotor blade spar revealed traces of rust. These rotor blades were replaced and the rotor tip lights were retained for possible later installation in the new blades by qualified depot maintenance personnel.



FIGURE 6-1. Suspect Water Leakage Point

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SECTION VII

OBJECTIVE 6 - INTELLIGENCE COLLECTION

53. (C) REACTIONS OF INTELLIGENCE PERSONNEL

a. During the evaluation, working level intelligence personnel cooperated fully with the INFANT crew members. They accepted enemy information with apparent eagerness and took immediate action when necessary. Insufficient returns of a combat intelligence questionnaire from intelligence supervisory personnel limited the documented reaction. The actual value of documented intelligence data collection using the AN/ASQ-132 is therefore limited.

b. It was frequently reported by other intelligence sources that INFANT had interrupted the enemy's movement on waterways, roads, trails, and known routes of infiltration. A specific incident in this category occurred when the AN/ASQ-132 detected and engaged what appeared to be an enemy supply point in operation. The following day, ground troops moved into the area and confirmed that INFANT had rendered ineffective an enemy rear service group resupply operations center. This information was considered to have intelligence value to the supported unit, as it provided insight into enemy activity in their area.

c. On another occasion, an armored platoon in an overnight defensive position detected movement around its perimeter. INFANT was diverted from another area to check out the reported movement. A target was detected and engaged near the perimeter and a reconnaissance at first light revealed six enemy KBH.

d. Checkout of many INFANT sightings by ground units usually confirmed the activity that had been reported. In one case, a mortar position detected by INFANT was neutralized by it before the enemy had a chance to strike.

e. The AN/ASQ-132 was also utilized in conjunction with DUFFEL BAG unattended ground sensors (UGS) that detect enemy ground movement. When a sensor was activated, INFANT was given the grid coordinates by radio; it then proceeded to the location to check the situation. A ground unit reported that, after INFANT engaged a target at the location of an activated sensor, further sensor activation was noticeably reduced. Several times when INFANT investigated UGS activations it was found that activity ceased while INFANT was in the area; however, it picked up again when INFANT departed the area. This is a possible indication that the enemy is concerned about detection from the air at night.

54. (C) MISSION REQUESTS

a. The most frequent intelligence information requested by a unit supported by INFANT was detection of enemy troop movement. The type of information desired was the location of the movement, the number of

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personnel, and their direction of travel. Reports on river traffic were also requested on some occasions.

b. Known or suspected infiltration routes were items of interest to the units that INFANT supported. There were constant requests to search such areas for enemy activity. Supported units also often requested search for enemy mortar positions that could attack a friendly base.

c. The AN/ASQ-132 was utilized infrequently in conjunction with other types of detection devices (e.g., SLAR, IR, DUFFEL BAG sensors) during the evaluation. DUFFEL BAG sensors and INFANT proved to be an effective team when employed together. However, SLAR and IR reports proved ineffective because they were too old by the time the INFANT received them. An exception to this occurred during Night Phantom Operations in IV CTZ, where a Mohawk/INFANT task force proved effective. When INFANT investigated SLAR or IR sightings shortly after detection, favorable results were normally achieved (see also Paragraph 42f and Appendix K).

d. Utilization of INFANT for intelligence gathering purposes did not always prove to be effective, since the majority of the missions were flown over dense jungle terrain (i.e., double and triple canopy). The only targets that could be detected under these conditions were light sources.

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SECTION VIII

OBJECTIVE 7 - FIREPOWER

55. (C) FIRE CONTROL EFFECTIVENESS

a. The 7.62mm miniguns (M134 automatic gun) proved to be the most useful component of the armament subsystem. This is largely attributed to their immediate strike capability. The apparent accuracy of the minigun, at normal INFANT attack ranges, is based on observed first burst impact on target. Of a total of 59 different engagements, 56 instances resulted in first burst hits on target, representing 95% effectiveness. The high rate of fire of the miniguns enabled the copilot/gunner to saturate a target in a minimum amount of time. As a result of system integration (sensor to guns), the operator of the DV subsystem was ready immediately to engage a detected target. This operation merely required depressing the M6 Actuator Bar (deadman switch) and pulling the trigger to fire both guns at 2400 spm (or to fire one at 4000 spm if aimed off longitudinal axis more than 12 degrees in traverse). Accuracy was increased by the operator's ability to track the dim tracer rounds to the target without enemy detection of the source of fire.

b. An insufficient amount of data was collected concerning the accuracy of the 2.75" FFAR during the evaluation. This is because the extreme amount of light emitted from the burning rocket temporarily blinded the operator. Also, when the trigger was depressed for rocket firing, the RV lens shutter automatically closed for approximately 1.5 seconds as protection for the intensifier tube. This prevented the operator from observing the initial flight path of the rocket. There were recorded, however, six occasions in which the operator reported first rockets on target. It should be noted that, in most instances, engaging a target with 2.75" FFAR rockets was not possible on the initial pass. This was due to the fact that INFANT was normally in close proximity to a target before detection occurred and because of the length of time required to align the helicopter for a rocket run using the RV. If the situation required rockets, a second pass was usually made on the target, with the operators engaging with both rockets and miniguns.

56. (C) SYSTEM USE FOR BATTLE DAMAGE ASSESSMENT (BDA)

In jungle-type terrain, especially double and triple canopy, it was very difficult to achieve any type of aerial BDA. In these situations, BDA was normally performed by ground troops. Unfortunately, the most useful BDA is an immediate one. However, on a number of occasions when enemy troops were detected on a trail or river, the AN/ASQ-132 was capable of observing results immediately after the target was engaged. When BDA was not possible on the initial pass, a second pass was made in an effort to make a more detailed BDA. BDA by operators was based on visible destruction, i.e., secondary explosions, bodies, and the neutralization of enemy firing positions.

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57. (C) INFANT VS NON-NIGHT VISION EQUIPPED ARMAMENT SYSTEMS

In most instances, 100 of 103 responses, missions conducted with the AN/ASQ-132 could not have been performed by other aircraft not equipped with a night vision system or artificial illumination. However, once a target was marked by INFANT, other armed aircraft could engage the target area.

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SECTION IX

OBJECTIVE 8 - MOBILITY

58. (U) INFANT IMPACT ON MOBILITY

a. To some extent, the AN/ASQ-132 was usable as an aid to night navigation during missions and while en route to and from the area of operation. This capability was most pronounced during missions involving road, trail, or waterway reconnaissance. With only limited light available, operators were able to navigate a road or waterway while observing for possible enemy activity. Limited navigational assistance was also possible in conjunction with surveillance in the vicinity of prominent terrain features such as ridge lines, large cleared areas, valleys, etc. Land barriers were used effectively as a guide in navigating within boxes bordered by rivers, roads, prominent tree lines, etc. Thorough map reconnaissance and questioning of personnel familiar with the area was found useful to the INFANT crew in the situation noted above. During cross-country flights, the AN/ASQ-132 was used as an aid in monitoring flight progress by observing prominent terrain features. Recorded data indicate that, during 41% of the missions, the AN/ASQ-132 was used as an aid to navigation. This should not be construed to mean that it was unusable during the other 59% of the missions, since a better means, such as GCA radar was available on many occasions.

b. Only during 7.8% of all missions did INFANT serve as a guide to other aircraft in cross-country flights or in finding fire support bases. The aircraft following did not fly in formation with INFANT, but rather in a manner that enabled it to maintain visual contact with INFANT.

c. Although the unit to which INFANT was assigned for the evaluation did not move from its location at Lai Khe, INFANT's presence would not have impaired the mobility of the unit. The ground support equipment (GSE) associated with INFANT is similar to that already found in the average aviation company TOE. INFANT-peculiar GSE can be carried in the semi-trailer maintenance van(s) that would become a part of the TOE of an INFANT organization.

SECTION X

OBJECTIVE 9 - ENEMY COUNTERMEASURES

59. (C) CONCEALMENT

a. The only known countermeasure employed by the enemy against the AN/ASQ-132 was concealment. The enemy normally hid until INFANT (or other aircraft) passed over, and then resumed his activities. This technique could prove successful against the AN/ASQ-132. A noteworthy incident occurred in light to heavy jungle-type terrain. In this case, an enemy force estimated near 30 was hidden undetected in an area while INFANT passed over. However, as the INFANT passed beyond the area the enemy began movement too soon and were detected by one of the INFANT door gunners. The pilot was informed and he immediately returned to the area and successfully engaged the target. This action resulted in an estimated 20 enemy KBH.

b. On another occasion, while conducting a road reconnaissance, an ox-drawn cart was detected moving on a road. The time required to recognize the target was too long to permit engagement on the initial pass. As the pilot aligned his aircraft for another pass, it became apparent the ox-cart had been concealed in the thick brush beside the road. The AN/ASQ-132 could not detect the target again; however, the pilot engaged the suspect area with flechette rockets and miniguns with unknown results.

60. (C) EFFECTIVENESS OF ENEMY COUNTERMEASURES

Concealment is an effective countermeasure against INFANT detection, although movement of the enemy appeared to slow down just by the presence of an aircraft in his area. This was illustrated by the fact that UGS activations diminished whenever INFANT approached a sensor-monitored area to investigate, even though it was unable to make detections with the AN/ASQ-132. It is also believed that the enemy exercised fire discipline rather than relinquish his concealment by firing at a low-flying INFANT. This finding is supported by the low number of ground fire incident reports during the evaluation, and is substantiated by reports of ground units that the enemy was believed to be operating in many of the INFANT's search areas. However, no further evidence is available to substantiate this opinion.

61. (C) POTENTIAL ENEMY COUNTERMEASURES

a. As the enemy becomes more aware of the INFANT capabilities and limitations, he could conceivably employ bright light sources such as high intensity lights and incendiary grenades to cause the AN/ASQ-132 sensors to shutter (close) the lens and render the system ineffective. Conversely such action would serve to expose the enemy's location enabling engagement by normal gunships.

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b. Although formation lights, dim tracers, and flash suppressors afford some measure of covertness to INFANT, other conventional counter-measures effective against aircraft, e.g., radar, acoustic, and IR fire-controlled antiaircraft fire, can be expected to be effective against INFANT also. Its searchlights would be detectable by metascope-type devices when they are being employed for supplemental illumination.

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SECTION XI

BASIS OF ISSUE

62. (U) POLICY GUIDANCE

The Department of the Army Combat Development Objectives Guide (CDOG) contains the following extracted organizational objectives for air-mobile operations and Army Aviation (Section I, Chapter 5, CDOG).

a. General Considerations.

To meet the requirement for rapid deployment to any area of the world, air mobile forces will be organized for specific operational missions and be capable of subsequent reorganizing for redeployment to new areas without significant changes. In addition, the integration of organic and attached aviation capability to the lowest feasible level will provide a greater degree of flexible responsiveness.* * * (511a, CDOG)

b. Specific Organizational Objectives.

Aircraft primarily designed for surveillance and target acquisition must be assigned to aviation units at division and corps levels, with the greater portion being at corps level in order to effect economy of manpower and equipment and permit the tailoring of forces. [511b (2), CDOG]

63. (U) FACTORS CONSIDERED

A basis of issue (BOI) for INFANT must consider many factors including, but not limited to the following.

a. Complexity of the System. The INFANT consists of three major subsystems, all of which must be operating properly for the weapon system as a whole to be considered operationally ready (OR). (See Paragraph 6 and Appendix A for a detailed system description.) Two of the subsystems are dependent upon normal aircraft and armament maintenance facilities, while the third, AN/ASQ-132, is dependent upon a special support package. (See Paragraph 22 and Appendixes C and D.)

b. Operator and Maintenance Skills Required. Specialized training for operator and maintenance personnel is necessary for effective INFANT operations. (See Paragraphs 37 and 38 and Appendixes H and I.)

c. Utility of the System. INFANT is a dedicated special purpose system not readily convertible for other missions. Although removal of

the periscope assembly and major components allows the system to be employed as a conventional UH-1 gunship, conversion is not practical on a short-term basis due to the extensive time (21.8 man-hours) required to remove, reinstall, align, and boresight the AN/ASQ-132 subsystem.

d. Operational Capabilities and Limitations. The INFANT system offers a significant night surveillance capability when operating over open terrain, but not over heavily wooded areas, since line-of-sight observation of the target is essential. When targets are detected, INFANT is capable of bringing immediate controlled fire on the target. Its utilization in specified strike zone (SSZ) areas exploits the weapon system's integrated target acquisition and fire control capability to the fullest. In addition, use of INFANT to investigate possible targets indicated by other sensors or intelligence sources is practical, although clearance to fire should be obtainable while the aircraft is en route to the potential target area in order to exploit INFANT's firepower capability. (See Sections II and V and Appendix K.)

e. Other Similar Devices Available Now or in the Future. Night Hawk systems (Reference 1k) provide a flexible night surveillance helicopter capability with limited firepower at division level, whereas INFANT offers an additional night surveillance capability (2 sensors). INFANT also has an integrated sensor/armament fire control system with the added firepower provided by 2.75" FFAR and an additional minigun. Night helicopter target acquisition and fire control systems under development (listed in Paragraph 76b) will also possess many of the INFANT characteristics. Although it is more than likely that some of these future systems will provide increased detection ranges over those presently obtainable with INFANT, the concept of employment for all of the new integrated night fire control systems should prove to be similar. Improvement in effectiveness is likely to evolve as additional operational experience is gained and technological advances in night sensors develop further.

f. Logistical Requirements. The logistical requirements of INFANT are characterized by the limitations normally associated with low density limited production materiel. For example, spare parts must be managed efficiently to maintain operational readiness. A limited inventory of INFANT-peculiar spare parts must be readily available to support the AN/ASQ-132 system. Centralized inventory control is necessary to insure adequate reorder action on long leadtime spares. In addition, non-standard items require special handling procedures to prevent loss of high cost INFANT-peculiar materiel in the normal supply system. INFANT ammunition (XM276, Dim Tracer) must also be controlled carefully to prevent accidental use in other weapon systems, which would constitute a waste of a special purpose item. This ammunition also requires thorough premission planning to insure availability of a supply of the ammunition in INFANT AO. Prestocking of ammunition should be avoided except at frequently used supply points in order to preclude an inventory requirement disproportionate to the actual usage requirement of dim tracer ammunition. On the other

hand, prepositioning of ammunition on a mission basis is essential for effective operations.

g. Personnel Requirements. INFANT aviators require special transition training prior to release for operational missions. This training requires 25 hours of flight instruction. Maintenance personnel also require special training in maintenance of the AN/ASQ-132. Present avionics and electro-optical MOS training do not provide all the required skills for maintaining the system. (See Section IV, Paragraphs 37 and 38.)

h. Quantity Available. USARV is to receive a total of 34 INFANT systems as a result of ENSURE 100. Additional procurement is not anticipated at the present time. Therefore, the USARV BOI should be predicated on this level of inventory.

1. Facilities to be provided for maintenance of the AN/ASQ-132.

(1) USARV

(a) Two Electronic Shops, Semitrailer Mounted, AN/ASM-189, each equipped with the INFANT Bench Test Kit and other special test equipment to provide for GS level maintenance.

(b) One Electronic Shop, Semitrailer Mounted, AN/ASM-189, equipped as shown in Appendixes C and D (used during evaluation). This van was judged adequate for limited GS maintenance.

(c) Four Electronic Shops, Transportable, AN/ASM-146, equipped for DS level maintenance.

(2) CONUS

One Electronic Shop, Semitrailer Mounted, AN/ASM-189, equipped with the INFANT Bench Test Kit to provide depot maintenance at Sacramento Army Depot (Signal) on a closed loop repair and return basis.

64. (U) ORGANIZATION DURING EVALUATION

The INFANT NETT and three systems were attached to an attack helicopter company of an assault helicopter battalion in an airmobile division. The NETT had an organic DS/GS capability for the AN/ASQ-132. It did not have any other organic maintenance capability except for three assigned crew chiefs and two armorers. Organizational, direct, and general support maintenance of the helicopters and armament subsystems were accomplished by the host organization within its organic capability and that of supporting elements. Attachment of INFANT to the attack helicopter company created what amounted to a 25% increase in helicopter and armament maintenance workload without the provision of any additional augmentation in maintenance personnel or equipment. Because of this situation, the NORM rate (40%) for INFANT during the evaluation is considered atypical.

65. (U) OPERATIONAL CONTROL DURING EVALUATION

INFANT was employed primarily under the operational control of the 1st Cav Div (AM). Through coordinated action with HQ II FFV, INFANT, on several occasions, was detached from the 1st Cav Div (AM) and placed under OPCCN of four other tactical organizations for periods varying from 3 to 10 days. In all but one case, INFANT was able to remain at its normal base airfield during these periods. The one exception required redeployment of personnel and equipment to a temporary base of operation 160 km from the regular INFANT home base. Displacement of INFANT 50 - 60 km from the regular home base to a forward airfield prior to a night's operation was commonplace. On these occasions, the forward airfield was used for fuel and ammunition stops between sorties. Operations in the 1st Cav Div (AM) were characterized by assignment of one INFANT per brigade per night, depending on system availability. Consideration of INFANT's capabilities and limitations was not apparent in this mission allocation, since only one brigade had suitable terrain in the TAOR. When other units received INFANT under OPCCN conditions on a limited basis, more effective employment was evidenced.

66. (U) DIVISIONAL VS NON-DIVISIONAL AVIATION ELEMENT

a. The present Night Hawk system is generally employed as a divisional element. However, there are significant differences between Night Hawk and INFANT, and these militate against a similar usage of INFANT assets. The Night Hawk field expedient system provides divisional aviation with a valuable night surveillance/interdiction capability. In addition, the ease with which Night Hawk components can be mounted and dismounted permits multipurpose use of utility helicopters to meet the many diverse tasks attendant on aviation support of a division's mission.

b. The aviation organizations found within a division structure are tailored to meet the support requirements peculiar to the type of division involved. The number and mix of aircraft are directly linked to stated capabilities in appropriate aviation unit TOE and normally relate to other nonaviation TOE found within the division. Likewise, the organic logistical support units found in a division's structure are also tailored to support the specific equipment found within the division. Additions or changes to major items of equipment affect the entire logistical train. Night Hawk utilizes components that are already common to existing logistical support of a division, whereas INFANT imposes many entirely new logistical and personnel requirements.

c. The inherent characteristics of many items of materiel make them readily adaptable to a wide variety of environmental situations while some materiel items are suitable to a given set of conditions. INFANT falls in the latter category, since its effectiveness is highly dependent upon terrain, disposition of friendly troops, availability of other means of fire support, and local ambient light conditions. In addition, INFANT is relatively inflexible. The modifications required to convert the UH-1M

airframe and M21 gun system to the INFANT configuration are extensive and, in effect, make INFANT a dedicated mission support item not readily convertible to other uses.

d. The evolution of another sophisticated airborne surveillance system (OV-1, Mohawk) has demonstrated the advisability of centralizing the equipment to optimize overall availability and provide a greater degree of flexible responsiveness to specific mission requirements. From earlier piecemeal organizations, the Surveillance Airplane Company became a viable organization when the need to increase efficiency necessitated the consolidation of high cost support equipment and highly specialized maintenance personnel. Greater management flexibility in shifting resources and thus minimizing the impact of resource limitations resulted through this consolidation. This evolution was also in observance of the CDOC objectives cited in Paragraph 62 above.

e. In view of the above, the INFANT system is not considered generally suitable for assignment as equipment organic to a division. It is considered suitable for attachment and integration with organic aviation.

67. (U) ORGANIZATIONAL CONSIDERATIONS

a. Basis of issue (BOI) criteria for systems of this type are believed to be nonexistent. INFANT and other similar night sensor equipped armed helicopters provide the Army with a new single package combination of capabilities -- passive surveillance, target acquisition, night observation, and integrated fire control -- in other words, a find, fix, and destroy capability. These first generation systems offer the means by which additional experience can be gained in operational procedures and techniques beyond that developed during this evaluation. The limited production of INFANT in an operational quantity (36) will assist in the development of concepts, doctrine, and organizational studies for future night attack helicopter operations.

b. During the immediate time frame, when only INFANT is available in an operational quantity, a provisional organization using existing resources, as recommended below, can provide the means with which to validate proposed Tables of Organization and Equipment (TOE) for future systems with similar performance characteristics. Based upon the number (34) of INFANT systems available to USARV under ENSURE 100, pilot training considerations, sensor maintenance considerations, inherent INFANT capabilities and limitations, sound employment practices, and overall management flexibility, several organizational approaches to a USARV BOI were studied. Four alternatives are discussed in detail in the following paragraphs. In listing the advantages and disadvantages of each alternative, relative comparisons to the other alternatives are used where applicable. The four alternatives are:

(1) INFANT as small team augmentation to divisions and aviation brigade elements supporting Delta Military Assistance Command.

(2) INFANT as four (separate and distinct) platoons by conversion of one platoon within each of four different existing aviation companies.

(3) INFANT as an aviation company (three operating platoons) and one independent platoon by conversion of an existing company and additional platoon from another company.

(4) INFANT as an aviation company with four operating platoons.

68. (U) INFANT AS SMALL TEAM AUGMENTATION TO DIVISION/AVIATION BRIGADE

a. Advantages

(1) Provides immediate operational response to parent organization.

(2) Enables optimum distribution when system capabilities and limitations are governing factors.

(3) Facilitates tactical coordination and gunship support.

b. Disadvantages

(1) Requires most AN/ASQ-132 support personnel.

(2) Necessitates augmentation of aircraft maintenance personnel in service platoon and DS aircraft maintenance units.

(3) Fragmentation of assets likely to produce lowest overall system operational readiness.

(4) Causes MTOE changes to largest number of units.

(5) Likely to produce highest turbulence as units are redeployed from RVN, in order to retain INFANT capability in-country.

(6) Widest distribution of personnel with special skills introduces largest training requirement.

(7) Prolongs the necessity for retaining a NETT.

(8) Requires special or additional ASL/PLL to support helicopter and armament subsystems depending on unit of assignment.

(9) Results in least economic use of AN/ASQ-132 maintenance capabilities.

(10) Precludes effective distribution of spares and test equipment to allow timely repair and/or replacement.

(11) Requires maximum redistribution of nonstandard items, increasing probability of loss and delay in shipment.

(12) Becomes most sensitive to system attrition.

(13) Offers least amount of management flexibility in personnel and logistical matters directly associated with INFANT.

69. (U) INFANT AS FOUR PLATCONS

a. Advantages

(1) Provides immediate operational response to supported organization.

(2) Facilitates assignment to each CTZ.

(3) Enables reassignment of integral units to other aviation units as dictated by redeployments.

(4) Allows tailoring to match available AN/ASQ-132 DS capability.

b. Disadvantages

(1) Requires more support personnel than if organized as a company.

(2) Distribution of personnel with special skills introduces large training requirement.

(3) Likely to result in lower overall system availability than with centralized organization.

(4) Creates adverse impact on parent organization, causing an imbalance in the tailored force.

(5) Requires four unit MTOE changes.

(6) Prolongs the necessity for retaining a NETT.

(7) May not utilize system capabilities to the fullest.

(8) Requires special or additional ASL/PLL to support helicopters and armament subsystems, depending on unit of assignment.

(9) Requires careful control and allocation of limited AN/ASQ-132 spare parts.

(10) Restricts flexibility in management of personnel and logistical matters associated with INFANT.

70. (U) INFANT AS AN AVIATION COMPANY (THREE OPERATING PLATOONS) AND ONE INDEPENDENT PLATOON

a. Advantages

- (1) Groups skilled personnel in a manner that reduces the impact of fluctuations in strength.
- (2) Uses near-minimum number of AN/ASQ-132 support personnel.
- (3) Likely to produce optimum operational readiness of overall systems.
- (4) Allows mission tasking to support many organizations.
- (5) Permits increased responsiveness to varying operational requirements of supported units.
- (6) Permits rapid tailoring of forces to meet changing operational requirements.
- (7) Results in a reduction in training requirements and allows partial integration of NETT into company.
- (8) Results in optimum span of control, if company's systems are employed in not more than two adjacent CTZs.
- (9) Permits conversion of existing aviation company with minimum adjustment of personnel and equipment by MTOE action.
- (10) Enables optimum utilization of available AN/ASQ-132 support equipment and spares.
- (11) Allows most practical consolidation of AN/ASQ-132 DS/GS maintenance.
- (12) Results in minimum redistribution of nonstandard items of supply.
- (13) Achieves better management and flexibility of personnel and logistical matters relating to INFANT.

b. Disadvantages

- (1) Requires special tasking directive to provide support across CTZ boundaries.
- (2) Indicates adverse impact on parent organization of independent platoon causing imbalance of tailored aviation force.
- (3) Causes loss of present assets in one aviation company, which may require retailoring of forces.

(4) May not be immediately responsive to the commander in the field depending on method of mission tasking.

71. (1) INFANT AS AN AVIATION COMPANY WITH FOUR OPERATING PLATOONS

a. Advantages

- (1) Groups skilled personnel in a manner that causes least impact of fluctuations in strength.
- (2) Uses least number of AN/ASQ-132 support personnel.
- (3) Allows highest operational readiness of overall systems when properly staffed and equipped.
- (4) Permits increased responsiveness to varying operational requirements of supported units.
- (5) Allows mission tasking to support many organizations.
- (6) Results in minimum training requirement and allows integration of entire NETT into company.
- (7) Utilizes assets of existing aviation company for conversion purposes.
- (8) Allows best economic consolidation of AN/ASQ-132 DS/GS maintenance.
- (9) Requires negligible redistribution of nonstandard items of supply.
- (10) Achieves centralization of management and permits flexibility in personnel and logistical matters relating to INFANT.

b. Disadvantages

- (1) Requires augmentation of normal company headquarters and service platoon personnel due to increased strength and logistical requirements.
- (2) Requires augmentation of personnel and equipment to constitute fourth operating platoon.
- (3) Restrains optimum utilization of systems when capabilities are concentrated in normal company size AO.
- (4) Requires mission tasking directive to provide support across boundaries.

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(5) Compounds communication, command, and control difficulties when employed in more than two adjacent CTZs.

(6) Requires the assets of one aviation company and one aviation platoon.

(7) Adversely affects the company furnishing the platoon to constitute the company.

(8) May not be immediately responsive to the commander in the field depending on method of mission tasking.

72. (C) SUMMARY

In summary, the most suitable BCI for USARV is contingent upon many considerations, some of which could not be addressed in this evaluation. Although the conversion of one existing aviation company and one platoon from another existing company appears to be the best course of action based upon stated considerations, the conversion of one existing platoon in each of four existing companies is logistically supportable after sensor maintenance personnel requirements are met. The latter may offer the least adverse overall impact upon USARV in view of the uncertain ultimate sustaining force posture to evolve in the future. A review of the implications of the preceding organizational structures as they relate to the AN/ASQ-132 follows.

a. Armed Night Surveillance Helicopter Sections. Organization of INFANT as sections augmented to existing aviation elements is considered uneconomical use of available resources and is likely to result in the lowest overall effectiveness of INFANT. A type maintenance structure for the AN/ASQ-132 is provided at Figure 11-1. It should be noted that the additional personnel spaces shown in the figure pertain only to the AN/ASQ-132. The overall impact of additional personnel and equipment requirements cannot be addressed until actual determination is made on which specific units are to receive INFANT and what quantity thereof. This course of action is not recommended.

b. Four Aviation Platoons (Armed Night Surveillance)(Provisional). Organization of INFANT in this manner is only considered feasible through conversion of existing platoons of aviation companies in order to provide the necessary personnel, equipment, and basic support required without prohibitive drawn-down of other operating units in order to form a provisional platoon. In addition, if these platoons were to be augmentations to existing aviation companies, additional requirements in company overhead and aircraft maintenance personnel and equipment must be considered as a liability above those assets required in support of the AN/ASQ-132. The AN/ASQ-132 estimated support requirements for four independent platoons are indicated in Figure 11-2. This course of action is supportable if accomplished through conversion of existing USARV aviation assets and with sensor maintenance augmentation.

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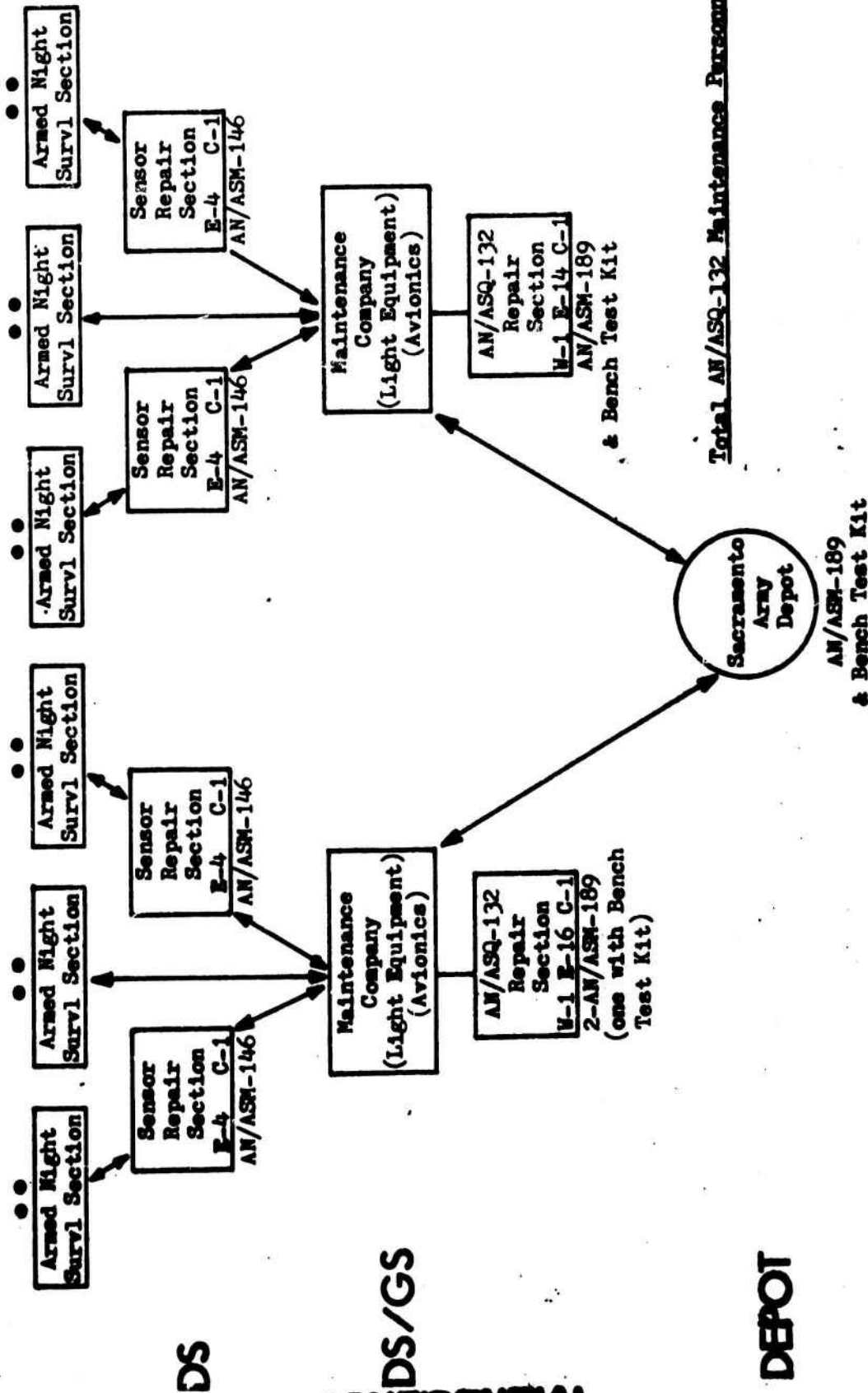


FIGURE 11-1. (U) Type Maintenance Structure, Six Armed Night Surveillance Helicopter Sections
(Varies according to end item support.)

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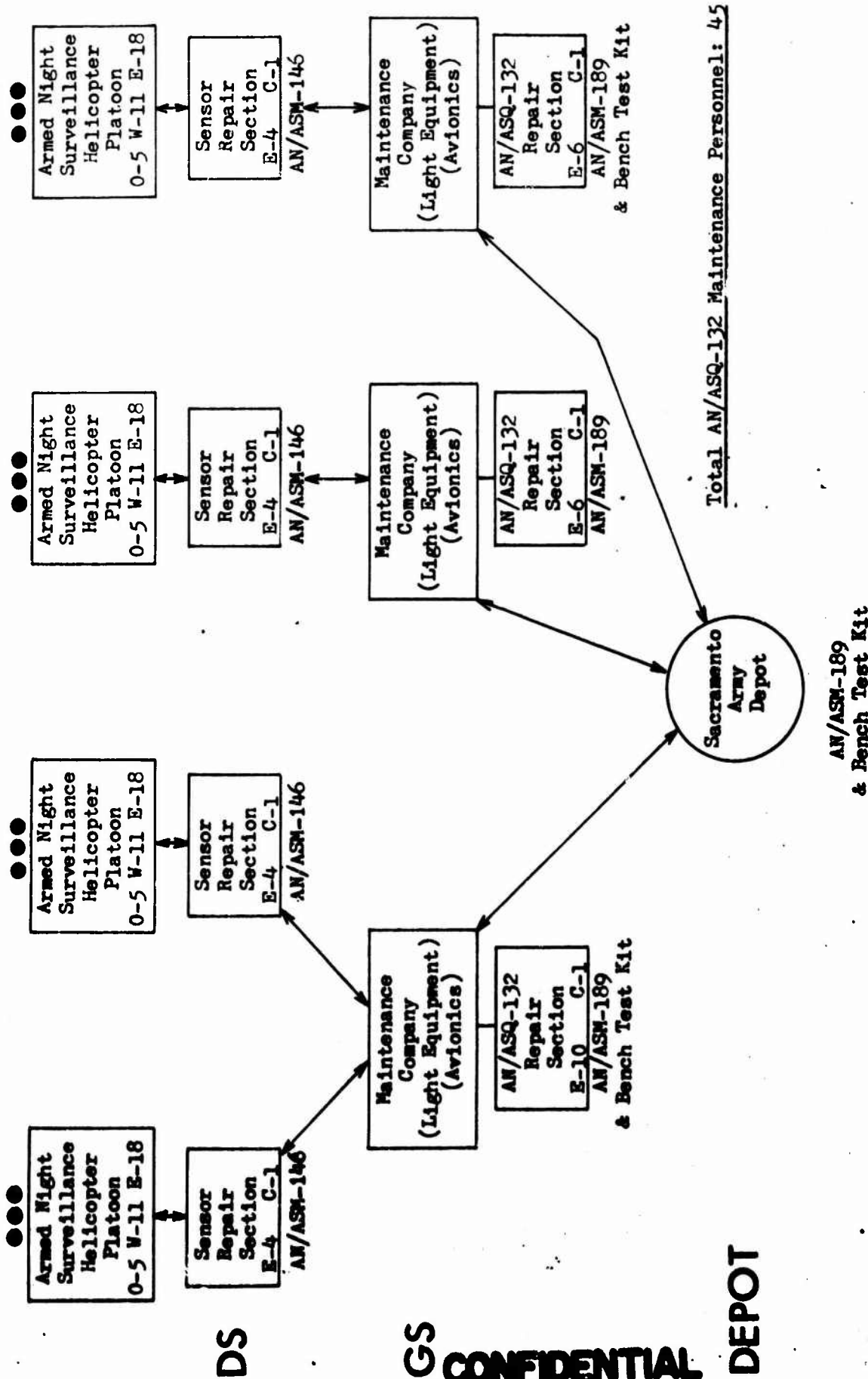


FIGURE 11-2. Maintenance Structure, Four Armed Night Surveillance Helicopter Platoons

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c. Aviation Company (Armed Night Surveillance) and one Aviation Platoon (Armed Night Surveillance).

(1) Company

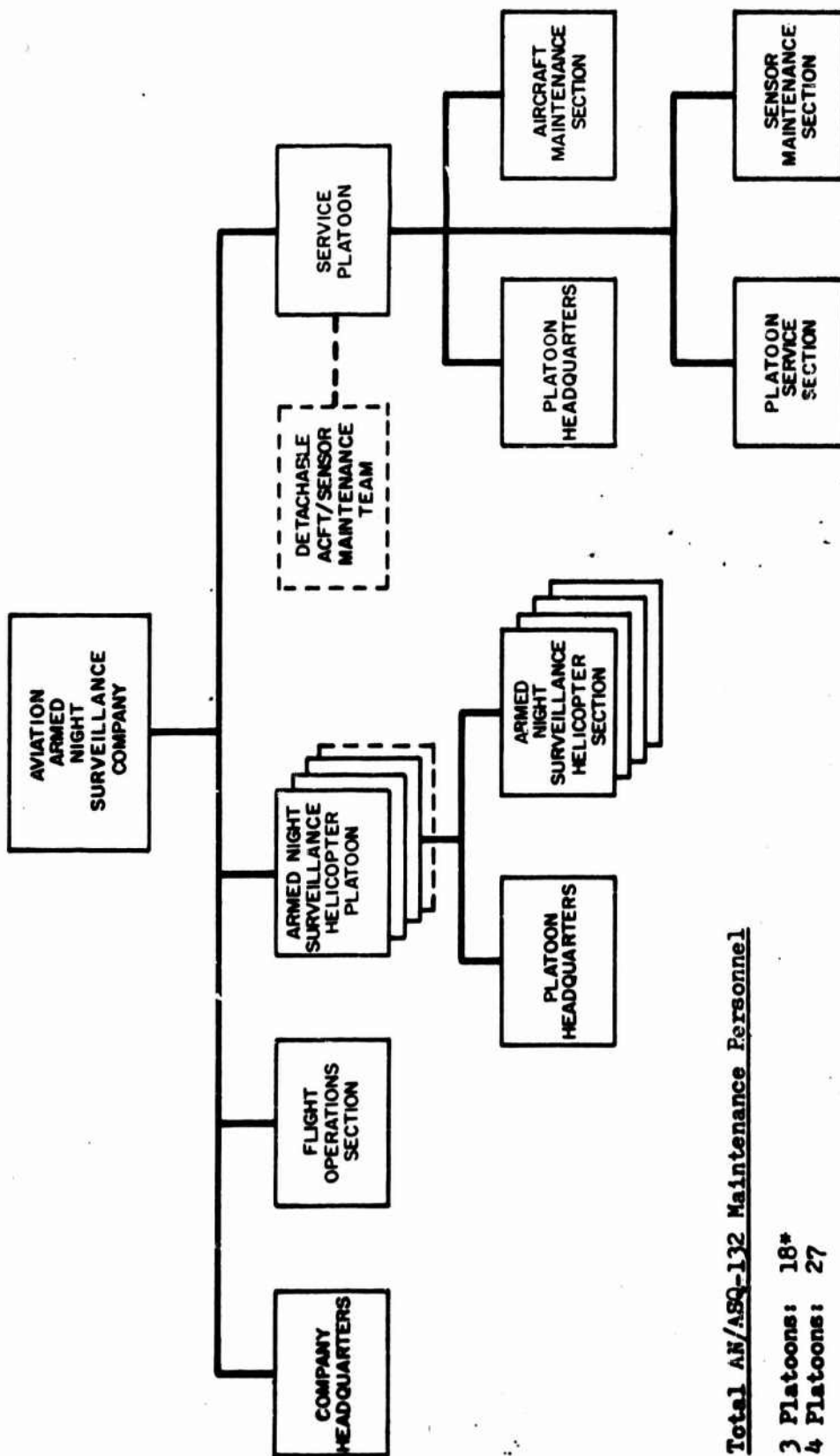
Results of experience obtained during the evaluation indicate a tentative allocation of one Armed Night Surveillance Company per CTZ. This allocation must be tempered by considerations of terrain, availability of other night interdiction capabilities, and economy of force. The INFANT system is particularly well suited for employment in areas where combined surveillance and interdictive firepower is limited or does not exist. (see Sections II and V). A company organization similar to the Aerial Weapons Company, TOE 1-111T, when equipped with UH-1C(A) helicopters, provides an ideal base for the proposed MTOE (see Figure 11-3). Augmentation of the service platoon is desirable in order to provide responsive sensor maintenance. This augmentation (based upon 24 INFANTS) will require 2 Electronic Shops, Semitrailer Mounted, AN/ASM-189, and 3 Electronic Shops, Transportable, AN/ASM-146 equipped for AN/ASQ-132 maintenance (only 1 Bench Test Kit necessary), 1 electronics repair technician, 1 AN/ASQ-132 maintenance supervisor, 14 AN/ASQ-132 repairmen, and 2 electronics equipment representatives (EER) DAC or contractor field service representatives (FSR) (See three platoon organization in Figure 11-4). Organic sensor maintenance has proven effective in the evolution of surveillance airplane companies. In order to maintain operational efficiency of the aviation company, a door gunner augmentation will also be required as is the normal case with UH-1C(A)-equipped companies. Since INFANT resources are limited, it is envisioned that initially a company of this type could be used efficiently to provide support to both III and IV CTZ by locating one platoon in the CTZ with the lesser requirement for night surveillance and interdiction. Although a company does not normally cross organizational boundaries, in this case the advantages of centralized management should outweigh the disadvantages of the split organization. Appropriate mission tasking can provide for priorities of support down to the platoon level without significant difficulty.

(2) Aviation Platoon (Armed Night Surveillance)(Provisional)

An aviation platoon consisting of eight INFANT systems is considered feasible. Organizational elements smaller than this are considered wasteful of resources and not economically manageable. A platoon can provide adequate support for those areas of I/II CTZ having suitable terrain and acceptable tactical conditions (generally open with likely areas for specified strike zones). An INFANT platoon will require ready access to, as a minimum: a DS maintenance facility equipped with an Electronic Shop, Transportable, AN/ASM-146 equipped for the AN/ASQ-132, and having one sensor equipment repair supervisor; three AN/ASQ-132 repairmen; and one EER. GS maintenance support will require augmentation of the appropriate maintenance company (Light Equipment) (GS) having an avionics support mission with one Electronic Shop, Semitrailer Mounted,

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AVIATION ARMED NIGHT SURVEILLANCE COMPANY
(BASIS: TOE I-IIIIT, AUGMENTED)



Total AN/ASQ-132 Maintenance Personnel

3 Platoons: 18*

4 Platoons: 27

* Plus 12 in support of another separate platoon.

FIGURE 11-3. (U) Provisional Armed Night Surveillance Company

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AN/ASQ-132 equipped for AN/ASQ-132 maintenance (with Bench Test Kit); one sensor equipment repair supervisor; five AN/ASQ-132 repairmen (dependent upon equipment density supported); and one EER or FSR (See Figure 11-5).

(3) This course of action is considered the best alternative if assets for conversion are available and mission tasking of platoons across CTZ boundaries is feasible, (i.e., DS/GS as opposed to OPCON).

d. Aviation Company (Armed Night Surveillance) with Four Operating Platoons. Although INFANT assets will permit this organization, it is not considered as efficient in as many aspects as the preceding alternative. This organization is portrayed in Figure 11-3 with augmentation platoon and detachable aircraft/sensor maintenance team. Requirements for equipment other than INFANT and DS sensor maintenance have not been computed for the additional platoon or maintenance team, as these are readily available in TCN staffing and equipment guides. Total AN/ASQ-132 sensor repair section requirements are indicated in the four-platoon support organization given at Figure 11-4. This course of action is considered most economically supportable from the standpoint of AN/ASQ-132 maintenance; however, operational considerations could make the alternative presented in Paragraph 72b above more desirable.

e. Conclusions. It is recognized that a USARV BOI for INFANT is dependent upon many variable factors beyond those considered in this study. The ultimate selection of a BOI for operational quantities of INFANT in RVN must be a compromise between all considerations and the degree of centralization to be employed. The factors considered in the preceding paragraphs are summarized below:

(1) Small Team Augmentation to Division/Aviation Brigade. This approach, which was the one used in the evaluation, provides the most responsiveness to the local commander and facilitates control and coordination with other airborne and ground divisional elements. It requires augmentation of regular aircraft maintenance personnel if operational readiness is to be maintained at the normal country-wide level, or sacrificing overall operational readiness of other aircraft to keep INFANT flying. It scatters the limited specialized support for the AN/ASQ-132 subsystem to the maximum extent, beyond the practical capabilities currently projected to be available; therefore, that subsystem will likely be the cause of non-operational time. This approach also fails to adequately consider the suitability of terrain, weather and the changing enemy situation. It does not take full advantage of INFANT's specialized capabilities, and it provides no flexibility to concentrate resources where needed.

(2) Four Separate Platoons. To the extent that eight INFANTs are concentrated in each platoon as opposed to three or four in the preceding alternative, this approach is preferred over the previous one. Some concentration of specialized maintenance support is achieved, perhaps enough. If the platoons are attached to existing aviation companies, considerable augmentation of regular maintenance support will be required, but very little additional overhead personnel would be needed. If the platoon is substituted for an existing platoon, the regular maintenance

Personnel		Key Equipment (in addition to MTOE 1-111T)	
Sensor Repair Section		Plus:	
1	Elct Repair Tech	1	APU, 7.5KW
1	Sensor Eq Repair Supv	1	HPU (Hyd Mule)
11	Sensor Eq Rpmn	4	Tool Kit Elec Eq TK-100/G
3	Sensor Eq Maint Appr	10	Tool Kit Elec Eq TK-105/G
2	Elct Equip Rep	1	Trk Cgo, 3/4T
or		1	Tent Maintenance (Acft)
2	Fld Svc Rep	Gen Set	
18		45 KW AC	
Elct Shop, Stlr-Mtd, AN/ASM-189 & Bench Test Kit		Elct Shop, Trans AN/ASM-146	
Elct Shop, Stlr-Mtd, AN/ASM-189		Elct Shop, Trans AN/ASM-146	
WO		Elct Shop, Trans AN/ASM-146	
E-7			
E-5			
E-4			
Civ			
Contr			

THREE OPERATING PLATOONS

Personnel		Key Equipment (in addition to MTOE 1-111T)	
Sensor Repair Section		Plus:	
1	Elct Repair Tech	3	APU, 7.5KW
2	Sensor Eq Repair Supv	3	HPU (Hyd Mule)
16	Sensor Eq Rpmn	8	Tool Kit Elec Eq TK-100/G
4	Sensor Eq Maint Appr	14	Tool Kit Elec Eq TK-105/G
4	Elct Equip Rep	3	Trk Cgo, 3/4T
or		3	Tent Maintenance (Acft)
4	Fld Svc Rep	Gen Set	
27		45 KW AC	
Elct Shop, Stlr-Mtd, AN/ASM-189 & Bench Test Kit		Elct Shop, Trans AN/ASM-146	
Elct Shop, Stlr-Mtd, AN/ASM-189		Elct Shop, Trans AN/ASM-146	
WO		Elct Shop, Trans AN/ASM-146	
E-7			
E-5			
E-4			
Civ			
Contr			

FOUR OPERATING PLATOONS

FIGURE 11-4. Sensor Repair Section, Avn Co (Armed Night Survl) for DS/GS Support

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Personnel

Key Equipment (in addition to normal TOE)

Sensor Repair Section		
1	Sensor Eq Repair Supv	E-6
3	Sensor Eq Rpan	E-5
1	Elct Equip Rep	Civ
	or	
1	Fld Svc Rep	Contr
<u>1</u>		
5		

Elct Shop, Transportable AN/ASM-146	Gen Set  15KW AC	Plus:	1 APU, 7.5KW 1 HPU (Hvd Mule) 1 Tool Kit, Elec Eq 2 Tool Kit, Elec Eq 1 Trk Cargo, 3/4T 1 Tent, Maintenance (Acft)	TK-100/G TK-105/G
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AN/ASQ-132 Repair Section		
1	Sensor Eq Repair Supv	E-7
4	Sensor Eq Rpmn	E-5
1	Sensor Eq Maint Appr	E-4
1	Elct Equip Rep	Civ
	or	
1	Fld Svc Rep	Contr
<u>1</u>		
7		

Elct Shop, Stlr- Mtd, AN/ASM-189 & Bench Test Kit	Gen Set  45KW AC	Plus: 1 APU, 7.5KW 1 HPU (Hyd Mule) 1 Tool Kit, Elec Eq, TK-100/G 4 Tool Kit, Elec Eq, TK-105/G 1 Trk Cgo, 3/4T 1 Tent, Maintenance (Acft)
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Total AN/ASQ-132 Maintenance Personnel: 12

FIGURE 11-5. Sensor Maintenance Structure for Separate Armed Night Surveillance Helicopter Platoon

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personnel would be adequate, but the helicopter assets of the original platoon would have to be redistributed in a manner to avoid overburdening some other unit, i.e., against present aircraft shortages. Support of the AN/AHQ-132 may be possible, but this alternative does not make optimum utilization of limited resources. Depending on command arrangements, responsiveness could continue to be immediate. Utilization of INFANT's specialized capabilities would depend on where the attachments were made. This approach does not provide much flexibility to move INFANT resources from one area to another without disruptive administrative and personnel arrangements. It does not provide for any centralized management of the INFANT operations and support.

(3) INFANT Company and One Separate Platoon. This alternative provides centralized management of INFANT resources, tailored to the terrain in RVN (it is visualized that the separate platoon would support I and II CTZ). It provides flexibility to move organic platoons from one location to another and attach them to organizations with impact only on administrative functions. The organization would require sensor maintenance personnel spaces, as in all other alternatives. Substitution of INFANT for existing helicopters and reallocation of the latter to fill shortages in other units requires 50 percent fewer personnel spaces than a similar substitution at platoon level. Responsiveness and optimum basing could, with the use of the proper employment doctrine, be achieved if it called for habitual mission assignment and basing of a specified number of INFANTs in support of various divisions and brigades. At the same time, the missions could be shifted by the Corps-level commander as the situation changed. This is the most flexible of the alternatives.

(4) INFANT Company with Four Platoons. This alternative is complete centralization with generally the same advantages and disadvantages discussed in the previous alternative; however, it does not adequately consider the geography of RVN, which almost dictates a separation of one element for the northern two military regions from the main concentration of INFANTs which should be in the Delta and Mecong Terrace. A four-platoon company extends the principle of centralization beyond the realities of the situation in RVN. It would require an unrealistic span of control for the company commander.

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SECTION XII

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

73. (C) RELATED QUALITATIVE MATERIEL REQUIREMENT (QMR)

Although INFANT was developed in response to an Expedited Non-Standard Urgent Requirement for Equipment (ENSURE) initiated by USARV, there is a QMR for a similar item. The current QMR (Paragraph 1539c (39), CDOC) is for a "Remote View Night Vision System (U)"; it calls for both ground and airborne systems. The airborne requirements are extracted as follows:

* * * passive, lightweight, remote view systems for image transfer of a night scene for air * * * observation. * * * This equipment must provide aviator/observers/gunners night observation; effective night firing of aircraft armaments; and improved night flying capability to include selective evaluation of terrain for tactical take-offs, landings, avoidance of obstacles, and nap-of-the-earth navigation. Night formation flight must be possible without detection of aircraft lights by ground or air observers. * * * A positive protection of the systems and personnel from intense light from outside sources must be included. The systems will be capable of quick installation, will have a capability for remote viewing under conditions of daylight as well as darkness and will be usable also in conjunction with infrared or conventional battlefield illumination. Range capability must be a minimum of 1000 meters with an approximate field of view of 32 x 24 degrees for aircraft applications (essential) 2000 meters (desirable) * * *.

This QMR is cited to provide the reader with background regarding this future goal for Army aviation. It is considered significant insofar as the INFANT evaluation provides advance findings for further consideration concerning this QMR.

74. (C) FINDINGS

a. Applicable to INFANT.

(1) The quality of the imagery was dependent upon moon phases (available ambient light) and the target-to-background contrast (11a and b).*

(2) When ambient light levels were low enough to require supplementary illumination from the IR searchlights, only the two narrowest fields of view in both the DV and RV subsystems were usable (11a).

* Numbers in parentheses () refer to paragraph(s) containing relevant discussion.

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(3) Sensor limitations restricted INFANT to altitudes of 600-1500 feet AGL with 600-800 feet AGL yielding the highest probability of target detection and recognition (11c).

(4) Most targets were recognized approximately 300-500 meters ahead of INFANT's flight path (13).

(5) Most first-pass engagements were made with miniguns, while rocket engagements were usually made on second or subsequent passes on a target (14 and 18).

(6) Ratios of detection ranges to engagements indicated that 68% of the targets detected could have been engaged on the first pass by either miniguns or rockets (15).

(7) The normal operating gross weight of the INFANT system imposed operating restraints common to heavily loaded aircraft (17).

(8) INFANT aircraft were NORM 40% of the evaluation and NORS 2% (20b).

(9) Mission availability for INFANT (the whole system) was 49%. The UH-1M helicopter and M21 armament subsystem alone yielded an atypical 56% availability. Total USARV UH-1C(A) fleet was reported available at a 67% rate during the same period. The added presence of the AN/ASQ-132 subsystem eroded total system availability by 7 percent (20).

(10) The ratio of AN/ASQ-132 maintenance (Org, DS & GS) man-hours to operating hours was 4:1. Organizational maintenance accounted for 28% of the effort with DS and GS requiring 51 and 21 percent respectively (21).

(11) The standard Army aircraft tow bar could be modified for use in ground handling of INFANT (22).

(12) The mean-time-to-repair (MTTR) for the AN/ASQ-132 was 11.6 man-hours; however, 5 of 65 failures had an inordinate influence upon this figure (23).

(13) The periscope assembly dolly transport was inadequate (24h).

(14) The mean-time-between-failures (MTBF) of the AN/ASQ-132 was 6.2 hours. Recurring failures accounted for 39% of the total number of failures (27b and c).

(15) Pilot's feet caught on the RV monitor mounting bracket when operating the anti-torque pedals (33b).

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(16) Interpretation of RV or DV imagery was accomplished without difficulty (34a).

(17) Better stray-light control was needed to reduce glare and reflections in the cockpit (34b).

(18) Searchlight beam was not compatible with all INFANT sensor FOV (34c).

(19) Available contrast range was inadequate in DV and RV displays (34f).

(20) A larger light shield was required on TV monitor (35a).

(21) INFANT did not present an extremely dangerous flight situation as previously reported during service testing (39).

(22) The AN/ASQ-132 provided a detection capability not available to the unaided dark-adapted eye (48f).

(23) INFANT could perform an intelligence collection role and was suitable for use in conjunction with other intelligence collection systems (53 and 54).

(24) Weapons integration with the AN/ASQ-132 was found to be effective and provided a capability not available to non-nightsensor equipped gunships or aircraft equipped with non-integrated sensors and weapons (55).

(25) The AN/ASQ-132 offered assistance as a night navigation aid (58).

(26) Concealment was the only known enemy countermeasure used against INFANT; however, other countermeasures are available to him (59).

(27) INFANT and its associated GSE did not have a significant impact upon unit mobility (58c).

(28) The Flight Line Test Kit is necessary for organizational maintenance (21b).

(29) The Viewer Test Kit is required at the organizational and DS level of maintenance (21b and 22b).

(30) The Bench Test Kit is required for efficient GS maintenance operations (22a, c, and 63j).

(31) Revetments of the "L" type construction are best for INFANT (17b).

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(32) Detection and recognition frequently occur simultaneously when using the AN/ASQ-132 (13).

(33) Door gunners are needed to provide support to INFANT organizations (Appendix E).

b. Applicable to INFANT and having implications for other armed night surveillance helicopters.

(1) Flash suppressors and dim tracer ammunition enhance covert characteristics (10d).

(2) Variable fields of view (apparent magnification) were useful in surveillance operations due to enhanced recognition capabilities (11c and 13).

(3) Operators preferred the highest possible altitude, under existing light and terrain conditions, in order to increase their detection/recognition slant range; the greater the slant range, the easier it is to engage a target on the first pass (11c, 13, and 14).

(4) Restrictions imposed by necessary rules of engagement inhibited the exploitation of targets of opportunity by integrated surveillance/fire control systems (11d).

(5) Battle damage assessment (BDA) in stability operations was difficult, and natural concealment found in RVN also impeded BDA (11e).

(6) Positive position location provided by GCA radar was necessary when operating in specified strike zones. A self-contained airborne position locator is required for use in surveillance aircraft when GCA is not available (14, 41, and 45b).

(7) The AN/ASQ-132 subsystem did not provide terrain avoidance or obstacle clearance except in gross terms (19 and 39). (See also Reference 1c.)

(8) The AN/ASQ-132 maintenance test package was found to be adequate except for shortcomings in subsystem test equipment and built-in-test-equipment (BITE). Special tools were constructed by the NETT for repair of recurring failures for which no tools or inadequate tools were provided (22, 23, and 24g(1)).

(9) Several maintenance operations were found to be excessively time-consuming as a consequence of inaccessibility, number of steps required, or number of personnel required (24).

(10) Maintenance and repair time was inefficiently expended when spare parts or test equipment were not available, or were delivered in defective condition (25b and c).

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(11) Preliminary Operating and Maintenance Manuals (POMM) were found to contain numerous errors (26).

(12) System main circuit breakers were not available to the crew in flight (31c).

(13) From a human factors point of view, controls were adequate; however, several shortcomings were noted. Positioning of AN/ASQ-132 controls relative to aircraft controls was the most significant shortcomings, followed by the operator's inability to discriminate between controls (32 and 33).

(14) Push-button type controls are not suitable for helicopter application unless the space between the button and its well can be sealed against the dusty environment (29g and 31b).

(15) The rear monitor did not significantly aid in system performance, and was not normally used (34b).

(16) The searchlights were found inadequate for several reasons, the primary one being mismatch of searchlight beam width to two widest fields of view of the RV and DV (34c).

(17) Pilot proficiency in instrument flying techniques is essential when using the AN/ASQ-132, and combat experience prior to training on the system is desirable (34d and 37).

(18) Some form of integrated flight status and command display is needed on real-time pilot fire control displays, along with a minimum safe altitude warning device (34d).

(19) A wider field of view is desirable (34e).

(20) Although field expedient corrective actions minimized the difficulty, pilots reported problems in maintaining night vision adaptation while using the AN/ASQ-132 (35a).

(21) DV operators reported eye fatigue and headaches after 4 hours of use. Aircraft vibration also caused discomfort. A preference for two RV subsystems was reported (35b, c, and 39).

(22) Focus rate of RV and DV subsystems was inadequate (35d).

(23) DV operators reported difficulty in maintaining look-angle orientation (35e).

(24) Crew coordination was not judged a problem, and independent sensors for pilot and copilot/gunner were considered an advantage (36).

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(25) Maintenance personnel required detailed knowledge in fundamentals of electricity, and a mechanical aptitude not specifically oriented with any given avionics or electro-optical MOS (38).

(26) The INFANT system could not be used effectively near bright light sources such as flares and perimeter lighting (45a).

(27) INFANT could not be employed effectively over canopied areas (45c).

(28) The relatively short detection ranges reduced opportunities for engagement of targets with rockets; frequently target overflight, which both alerted the enemy and exposed the INFANT aircraft to hostile fire, occurred before a suitable rocket attack profile could be achieved (45d).

(29) When employed in armed reconnaissance missions INFANT was capable of finding and destroying enemy targets under nighttime conditions; the methods used, however, were quite different from day attack helicopter operations (46).

(30) The covert features of flash suppressors and dim tracer ammunition made target marking for non-sensor equipped aircraft difficult (47a).

(31) Fléchette rockets were more effectively employed with INFANT than were HE warheads (47b).

(32) Effective utilization of INFANT was dependent upon the supported ground forces having a thorough knowledge of system capabilities and limitations (48).

(33) Ground secure exterior lighting was essential on night attack helicopters; however, improvements are required in the present system (50 and 51).

(34) Electronic maintenance vans supporting sensor equipped aircraft should be outfitted with a standard aircraft auxiliary power cable to permit use of the van's 28 VDC source on aircraft parked in proximity to the van (22a).

75. (C) CONCLUSIONS

a. The INFANT system is capable of detecting and engaging targets under nighttime combat conditions in RVN. Overall effectiveness is influenced by mission planning, available ambient light, terrain characteristics, detection slant ranges, and crew knowledge of exact position over the terrain.

b. The reliability and maintainability characteristics of INFANT are acceptable; however, improvement is needed in quality control over manufactured spare components, and additional test equipment and tools are required for more efficient use of maintenance time. Correction of

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deficiencies in recurring component failures should measurably improve system reliability, and improved component accessibility should reduce MTR.

c. With adequate aircraft maintenance support, INFANT availability should approach 65%.

d. Readily accessible DS maintenance facilities are necessary to insure acceptable operational ready status for the AN/ASQ-132 as system complexity requires a preponderance of maintenance at that level.

e. Use of built-in-test-equipment (BITE) is essential to reduction of maintenance time on systems of this type. Rapid flight line identification of subsystem failures down to line replaceable unit (LRU) alleviates the need for highly skilled maintenance personnel at the organizational level, and permits cost-effective utilization of high-cost diagnostic equipment.

f. Operation of INFANT requires aviators proficient in instrument flight.

g. Specialized training (25 flight hours) is required for INFANT operators, and for AN/ASQ-132 maintenance personnel (193 hours).

h. Additional automation of control functions is indicated in order to reduce overall demands placed upon the pilot. Repositioning of field of view and sensor position controls, provision of integrated flight status and command information of the pilot's TV monitor, and more efficient control of display glare are also indicated needs.

i. INFANT is best employed (1) in a fire team, (2) in generally open terrain or over waterways, (3) in conjunction with other area or zone-type surveillance or detection devices, (4) under moonlit conditions, and (5) in specified strike zones or where clearance to engage targets is readily available.

j. From a resources management and system capability point of view, the optimum basis of issue for INFANT in USARV is one aviation company supporting III and IV CTZ and one aviation platoon supporting I and/or II CTZ. Organization is well suited to MTOE 1-111T with sensor maintenance augmentation. The company should have an organic or attached DS/GS AN/ASQ-132 maintenance capability. Additional user experience for future night surveillance helicopter operations can best be obtained by means of company sized organization. Alternative BOI are also considered feasible and overriding operational considerations may dictate their application.

k. One armed night surveillance helicopter company should be adequate for assignment as a corps element within a type field army.

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Ultimate BOI will be dependent upon night capability of ground forces and troop carrying helicopters.

l. The Navy Formation Lights (540 Rotor System) are not adequate for gunship use due to limited range at which another aircraft can maintain visual contact. The present system needs improved detectability to ranges three times as great as are now possible. The small size (surface area) of the present electroluminescent (EL) panels appears to be the limiting factor. Formation lights (or combat lights) not visible from the ground are necessary for night airborne operations. Rotor tip lights should be automatically extinguished when sensors are placed in a rocket firing run configuration.

m. The AN/ASQ-132 is capable of collecting combat intelligence as an airborne nighttime surveillance system and is limited only by sensor detection ranges and field of view.

n. The INFANT system does provide a nighttime fire control capability for placing aimed fire on targets without visible illumination of the battlefield.

o. INFANT can assist units in night movement with its capability to provide armed reconnaissance of the route of march and ambush neutralization.

p. INFANT imposes no significant logistical impact on a unit's ability to move, since its ground support equipment is mobile.

q. Concealment is the primary enemy countermeasure against INFANT, although he may achieve more positive results by using bright light sources to blank out the sensors.

76. (U) RECOMMENDATIONS

a. That no further procurement of AN/ASQ-132 subsystems be made at this time.

b. That further development of night attack or surveillance helicopters be deferred until evaluations of the Night Vision Sight, Stabilized, AN/USQ-45 (Hueycobra); Fire Control System, Infrared AN/AAQ-5 (FLIR); Night Vision System, Passive Infrared, AN/ASS-29 (FLIR); Cobra Night Fire Control System (CONFICS); and Southeast Asia Multisensor Armament System, Hueycobra (SMASH) are completed and synthesized.

c. That night operating helicopters equipped with real-time displays include integrated flight displays to provide selectable flight status and command information for specific flight profiles.

d. That all helicopters including gunships be equipped with ground secure night formation lights with adjustable intensity and of

sufficient size to be distinguished at a distance of 1500 feet when on midintensity setting. Also, that rotor tip lights be configured to extinguish automatically during firing runs involving a dive.

e. That night surveillance or attack helicopters be equipped with a self-contained navigator to provide continuous present position data with UTM grid coordinate readout, pictorial terrain viewer, and absolute altimeter (see CLOG, Para 533b(6)) or a position-fixing and navigation system as described in Paragraph 533b(13) of CDOG with an absolute altimeter.

f. That night surveillance aircraft be equipped with a covert target designation capability compatible with night attack helicopters and close air support aircraft.

g. That night attack helicopters be capable of receiving target designation information from surveillance aircraft.

h. That further study be made of the use of armed night attack helicopters in conjunction with unattended ground sensors (UGS) and OV-1 Mohawk surveillance aircraft to determine systems interface and effectiveness.

i. That USARV organize INFANT into one provisional aviation company (armed night surveillance) under MTOE 1-111T and one provisional aviation platoon (armed night surveillance) by conversion of existing aviation elements, using available INFANT resources as indicated in Section XI, Paragraph 72c, and providing personnel augmentation for AN/ASQ-132 maintenance.

j. That Phase II/III INFANT systems be evaluated by those units assigned these systems to determine which shortcomings, if any, determined in this evaluation have been improved and/or corrected as a result of design changes incorporated into Phase II/III INFANT systems.

APPENDIX A

AN/ASQ-132 SUBSYSTEMS AND ELECTRONIC EQUIPMENT (U)

1. (U) GENERAL

The AN/ASQ-132 system is composed of 20 different units that comprise three functionally independent subsystems. These subsystems are: direct view subsystem, remote view subsystem, and searchlight subsystem. Some of the units in the system are used as components of more than one subsystem. See Figure A-1 for component locations.

a. Direct View Subsystem - The function of the direct view subsystem is to provide an electronically intensified (brightened) image as viewed by the direct view tracking periscope and transmitted by means of a fiber optic bundle. The direct view subsystem is composed of the following units: periscope assembly (001 unit), direct view tracking periscope (004 unit), direct view optical sight intensifier (005 unit), signal data processor (008 unit), electronic stabilization control amplifier (009 unit), low voltage power supply (010 unit), AN/ASQ-132 system control panel (012 unit), direct view high voltage power supply (015 unit), and overvoltage absorber (017 unit).

b. Remote View Subsystem - The function of the remote view subsystem is to provide an electronically intensified (brightened) image as viewed by the remote view tracking periscope by means of a closed-circuit television system. The remote view subsystem is composed of the following units: periscope assembly (001 unit), remote view tracking periscope (006 unit), remote view television camera (007 unit), signal data processor (008 unit), electronic stabilization control amplifier (009 unit), low voltage power supply (010 unit), remote view periscope positioning control (011 unit), AN/ASQ-132 subsystem control panel (012 unit), remote view high voltage power supply (014 unit), overvoltage absorber (017 unit), rocket flash protection (021 unit), observer television monitor (902 unit), and two cockpit television monitors (903 unit) (one each for the pilot and copilot).

c. Searchlight Subsystem - The function of the searchlight subsystem is to provide additional illumination when the light level at maximum system intensification is insufficient to provide a good image of the scene being viewed. The searchlight subsystem is composed of the following units: overvoltage absorber (017 unit), AN/ASQ-132 system control panel (012 unit), two searchlights (904 unit), and the searchlight junction box (905 unit).

2. (U) TECHNICAL CHARACTERISTICS OF THE AN/ASQ-132 SUBSYSTEM

General technical characteristics of AN/ASQ-132 units are given in Table A-1; unit peculiar characteristics are given in Table A-2; and unit carrying case information is given in Table A-3 and illustrated in Figure A-2.

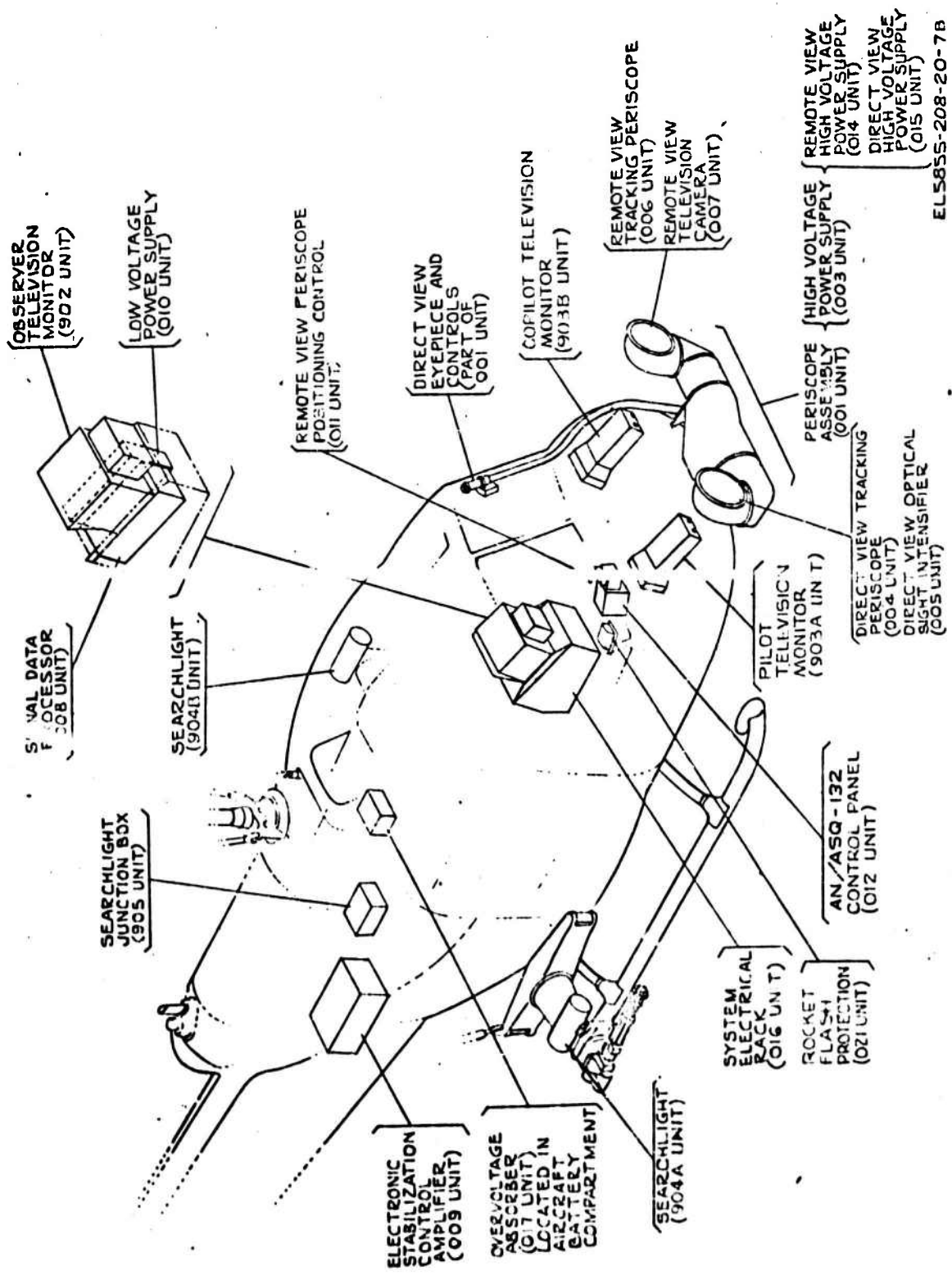


FIGURE A-1. Location of AN/ASQ-132 Units in Aircraft

TABLE A-1 (U)

AN/ASQ-132 UNIT GENERAL CHARACTERISTICS

Unit	Depth (inches)	Width (inches)	Height (inches)	Weight (pounds)	Power requirements	Heat dissipation (watts)
001	24.4	60.3	25.6	286	.....	.....
003	10.75	7.6	9.5	20	+28v	.....
004	14.0 (minimum)	24.5	25.5	125	+15v, +28v, +30v	.....
005	10.0	9.4	9.5	17	0 to +18kv, 0 to -18kv, 0 to -2kv, 1kvac	.....
006	12.0 (minimum)	29.5	25.5	115	+15v, +28v, +30v	.....
007	27.1 (excludes cables)	9.4	9.5	21	-15v, +30v, 0 to 100v, +300 v, +340v, +360v, 0 to +18kv, 0 to -18kv, 0 to -8kv, 0 to -2kv	.....
008	19.9	10.24	8.1	28.9	+15v, +28v, +30v	60
009	20.7	12.0	9.0	38	+15v, +28v, +30v, 115v 400Hz single phase	600
010	16.6	2.25	11.5	13.5	+28v	100
011	3.7	5.7	8.9	3.0	+15v	.....
012	5.75	8.4	7.50	6	+12v, +28v	10
014	7.8	3.8	9.5	9.5	+28v	17.5
015	7.8	3.8	9.5	9.5	+28v	17.5
016	24.0	14.5 (excludes mounting brackets)	19.1 28.9 (with observer television monitor mounted)	22.0	.....	.....
017	10.8	11	2.5	6.0	+28v, +3v	130
021	3.75	2.12	1.0	0.6	+28v	.....
002	18.25 (includes hood)	16.0	12.3	37	+28v, 115v, 400Hz single phase	130

TABLE A-1 (Continued)

AN/ASQ-132 UNIT GENERAL CHARACTERISTICS

Unit	Depth (inches)	Width (inches)	Height (inches)	Weight (pounds)	Power requirements	Heat dissipation (watts)
903	21.1 (includes hood)	8.9	8.8	19.5	+28v, 115v 400Hz single phase	70
904	15.0	6.2	8.2	14.0	+28v	700 maximum
905	12.7	8.1	5.1	18.0 (plus 5 lb for each cable)	+28v	250

TABLE A-2 (U)

AN/ASQ-132 UNIT PECULIAR CHARACTERISTICS

Unit and characteristic	Parameter
004 Image magnification ratios	1.000, 0.600, 0.429, 0.3125
Field of view	
1.000 magnification	6.20 degrees angular diameter
0.600 magnification	10.33 degrees angular diameter
0.429 magnification	14.48 degrees angular diameter
0.3125 magnification	19.85 degrees angular diameter
Focus range	150 feet to infinity
Traversing and elevation limits	
Azimuth	+70 degrees
Elevation	+15, -80 degrees
006 Image magnification ratios	1.000, 0.600, 0.429, 0.3125
Fields of view	
1.000 magnification	7.36 degrees azimuth, 5.51 degrees elevation
0.600 magnification	12.27 degrees azimuth, 9.20 degrees elevation
0.429 magnification	17.20 degrees azimuth, 12.88 degrees elevation
0.3125 magnification	23.55 degrees azimuth, 17.65 degrees elevation
Focus range	10 feet to infinity
Traversing and elevating limits	
Azimuth	+70 degrees
Elevation	+15, -80 degrees
011 Limits of handle movement	
Forward	80 degrees
Aft	20 degrees
Left	75 degrees
Right	75 degrees

TABLE A-3 (U)

CARRYING CASES

Vendor Part No.	Stencil nomenclature	Hardware contained	Carrying case weight, including hardware (pounds)	Carrying case dimensions less clasps (inches)
D23183	Processor, signal data	008 unit	53	20x26x15
D23184	Amplifier, electronic control stabilization	009 unit	74	20x26x15.5
D23185	Power supply, low voltage	010 unit	50	17x21x18
	Control, periscope positioning remote view	011 unit		
	Panel, control INFANT system	012 unit		
D23186	Monitor, television, observer	902 unit	82	24x26x16.5
D23187	Monitor, television, pilot	903 unit (2)	79	24x26x16.5
D23188	Searchlight junction box, Searchlight cables, Searchlight	905 unit 904 unit (2)	107	20x26x18
D23189	Assembly, periscope	3166058 part of 001 unit	112	27x37x18.5
R23181	Periscope, tracking Direct view	004 unit and 3166486	225	42.5x69.5x22
R23546	Periscope, tracking Remote view	006 unit	165	29x45x20.5

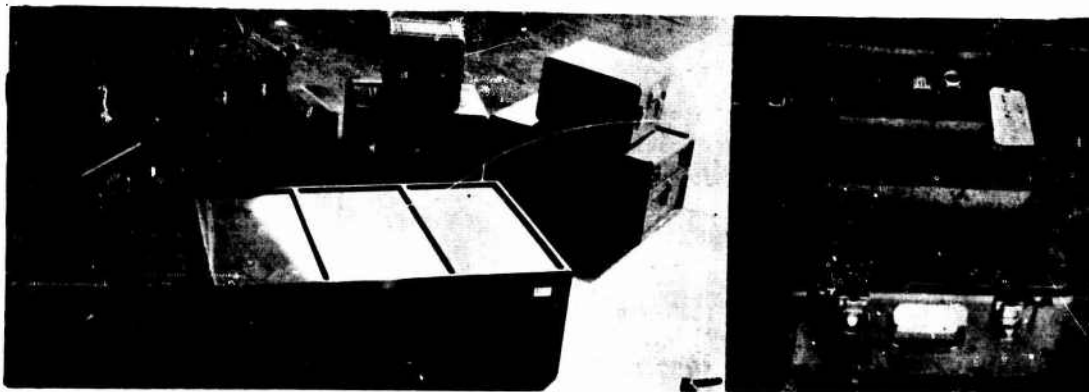


FIGURE A-2. AN/ASQ-132 Carrying Cases including inside view

3. (U) DESCRIPTION OF EQUIPMENT COMPONENTS

a. Periscope Assembly (001 unit) (Figure A-3) - The periscope assembly is an assembly of three units: direct view tracking periscope (004 unit), remote view tracking periscope (006 unit), and high voltage power supply (003 unit). The direct view and remote view tracking periscopes are assembled at opposite ends of the periscope mount assembly, which contains the high voltage power supply, some filtering circuits, and wiring harnesses. The rear of the periscope mount assembly contains eight multi-pin electrical connectors and an opening for the fiber optic bundle. The connectors attach to electrical cables which transfer signals and power between the periscope assembly and AN/ASQ-132 units in the aircraft. The fiber optic bundle is routed through an opening in the lower left-hand corner of the left windshield. Inside the helicopter, the fiber optic bundle terminates with an eyepiece. A control housing is fastened to the eyepiece and contains the direct view operating controls. The periscope assembly is constructed primarily of aluminum alloy which protects the components inside and provides a rigid mount for the optics assemblies.

(1) Direct view tracking periscope (004 unit) - The 004 unit constitutes the right side of the 001 unit. It consists of three main housings which move (stovepipe-like) in relationship to each other. The face of the top housing is a window. Inside the top housing is a mirror with gyroscopes mounted on its reverse side. The corner housing contains lenses, a shutter assembly, a prism, and servomotors for turning the top housing with respect to the corner housing. The housing which connects the 004 unit to the periscope mount assembly contains the direct view optical sight intensifier (005 unit) (Figure A-4) and servomotors for turning the corner housing.

(2) Remote view tracking periscope (006 unit) - The 006 unit is very similar to the 004 unit. However, instead of using a fiber optic bundle, the 006 unit contains the remote view television camera (007 unit) (Figure A-5) which terminates with a vidicon tube.

(3) High voltage power supply (003 unit) (Figure A-6) - The high voltage power supply comprises two units: remote view high voltage power supply (014 unit) and direct view high voltage power supply (015 unit). These two units differ only slightly. The two units are mounted in a rack which secures them in the helicopter and provides isolation from vibrations. Each of the units is housed in a metal case. One side of each case is removable to provide access to the circuits inside. Each of the cases contains three circuit cards and circuitry mounted on the chassis. Each of the units has two input connectors at the bottom and several output connectors near the top of the same panel.

b. Signal Data Processor (008 unit) (Figure A-7) - The 008 unit is mounted in the system electrical rack (016 unit). It is housed in a metal case, both sides of which are removable to provide access to the chassis. The front panel contains a handle, two elapsed time meters, and two indicator lamps. The rear panel contains the 17 electrical connectors

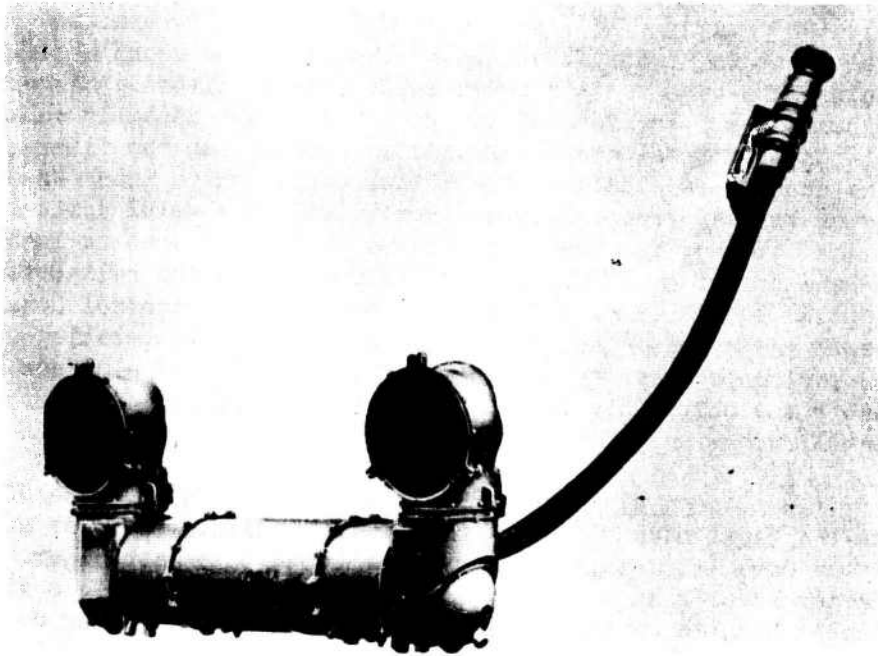


FIGURE A-3. Periscope assembly (001 unit)



FIGURE A-4. Direct view optical sight intensifier (005 unit)



FIGURE A-5. Remote view television camera
(007 unit)



FIGURE A-6. High voltage power supply
(003 unit)

for the unit. Circuits are contained on 13 removable cards and on the unit chassis. In addition, the unit has two spare circuit card locations and an extender card.

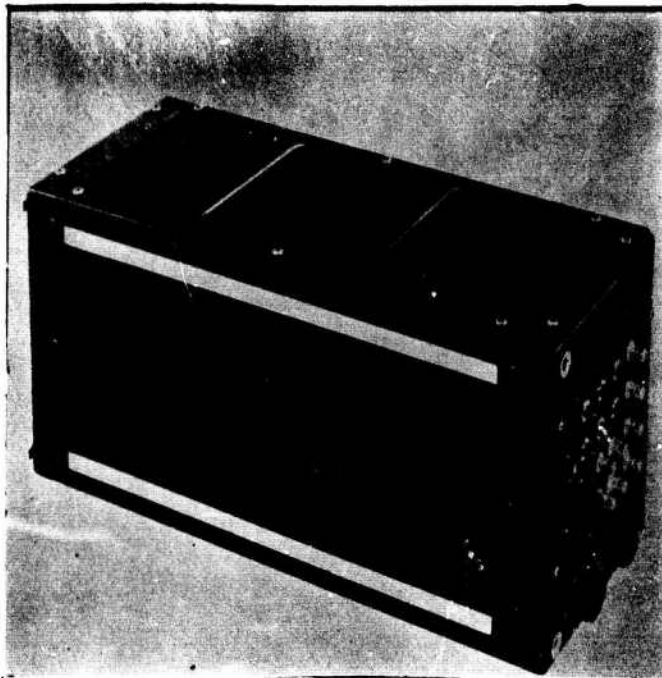


FIGURE A-7. Signal data processor (008 unit)

c. Electronic Stabilization Control Amplifier (009 unit) (Figure A-8) - The 009 unit is housed in a metal case. The rear panel contains an intake port for cooling air. The front panel contains a cooling air exhaust port, four electrical connectors, an elapsed time indicator, and two handles. Circuits are mounted on ten removable cards and a heat exchanger assembly. The heat exchanger assembly contains a blower to provide cooling air for the components mounted on the heat exchanger.

d. Low Voltage Power Supply (010 unit) (Figure A-9) - The 010 unit is mounted in the 016 unit along with the 008 unit. It is housed in a metal case. The front panel contains four electrical connectors, an elapsed time meter, and an indicator lamp. The electrical circuits are accessible by removing one side of the unit. Circuits are mounted on a card and on the unit chassis. The circuit card is hinged on one edge so that it can be swung out to provide access to the chassis-mounted components.

e. Remote View Periscope Positioning Control (011 unit) (Figure A-10) - The 011 unit is mounted on the helicopter pedestal. The control handle protrudes from the top of the housing and can be moved forward and

aft in the opening in the case. It also can be rotated about the axis of the attaching shaft. The unit is removable by disengaging four quarter-turn fasteners. An electrical connector is mounted at the bottom of the unit.

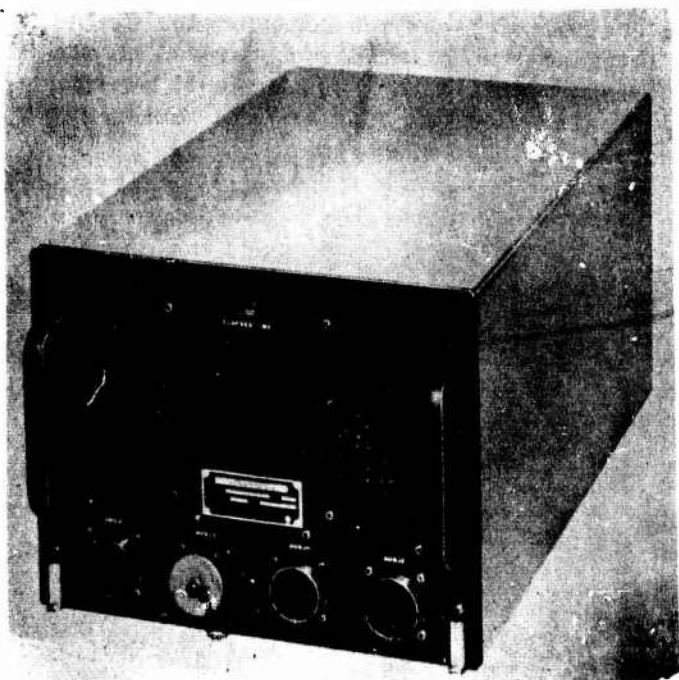


FIGURE A-8. Electronic stabilization control amplifier (009 unit)

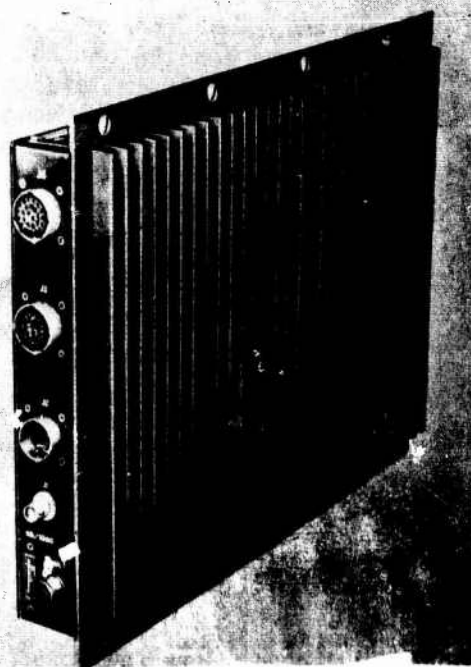


FIGURE A-9. Low voltage power supply (010 unit)



FIGURE A-10. Remote view periscope positioning control (011 unit)

f. AN/ASQ-132 System Control Panel (012 unit) (Figure A-11) - The 012 unit is also mounted on the helicopter pedestal. It is housed in a metal case which has two holes in the back for electrical connectors. Electrical circuits are mounted on three removable cards and on the unit chassis. The front panel of the unit is of two-piece construction with components mounted on the back plate and the nomenclature engraved on the front plate. It is luminous to provide panel lighting. The unit may be removed from the pedestal by disengaging the four quarter-turn fasteners and disconnecting the two electrical cables at the rear.



FIGURE A-11. AN/ASQ-132 system control panel (012 unit)

g. System Electrical Rack (016 unit) - The 016 unit is the mount for the 008 unit, 010 unit, and the observer television monitor (902 unit) to be used by personnel in the rear seat. The 008 unit is mounted in the lower center of the unit and the 010 unit along the lower left side (as viewed by a person in the rear seat). The 902 unit is mounted on the top of the rack.

h. Overvoltage Absorber (017 unit) (Figure A-12) - The 017 unit is mounted in the helicopter battery compartment. It consists of electrical components mounted on a dissipating heat sink. The unit has no case. A mounting bracket is provided at each corner of the heat sink to secure the unit.

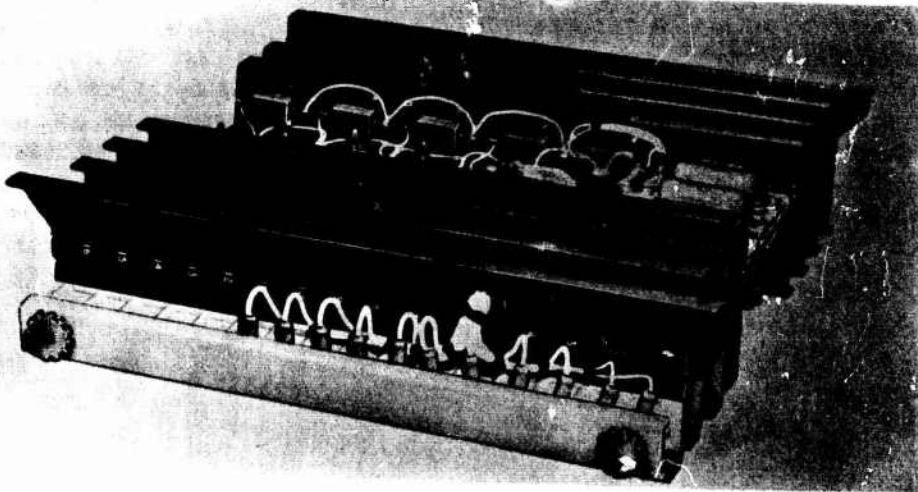


FIGURE A-12. Overvoltage absorber (017 unit)

i. Rocket Flash Protection (021 unit) (Figure A-13) - The 021 unit is attached to the helicopter floor beneath the control pedestal by 4 bolts. The unit consists of a single circuit board completely enclosed for protection. It is attached to an aluminum alloy mounting plate. One end of the unit contains a coaxial plug. Two wires at the opposite end pass through a plastic clamp which provides strain relief.

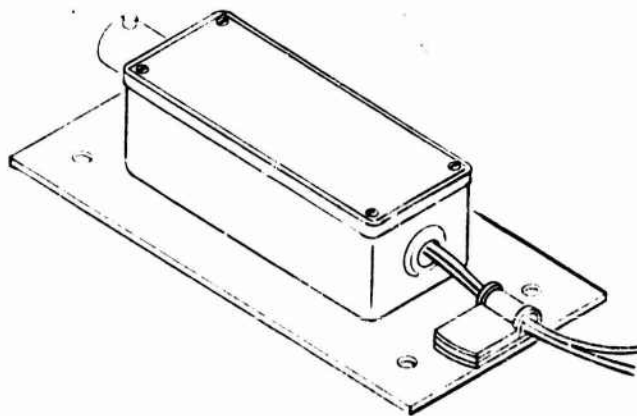


FIGURE A-13. Rocket flash protection (021 unit)

j. Observer Television Monitor (902 unit) (Figure A-14) - The 902 unit is mounted on the 016 unit at the rear of the cockpit. It has a 14-inch screen. Clamps for holding filters are located around the screen. Permission controls, protected by a removable captive cover, are

located at the bottom left corner of the front of the unit. Most of the electrical circuitry is mounted on four circuit cards at the rear of the unit and enclosed by two shields. The circuit enclosure is cooled by a blower which draws air in the bottom of the circuit enclosure and exhausts it at the rear. The entire circuit enclosure is shielded to protect against EMI and RFI leakage and dust. The unit's high voltage power supply and a filter are located inside. Four electrical connectors and a fuse are located along the bottom at the rear. A handle is on each side of the unit.

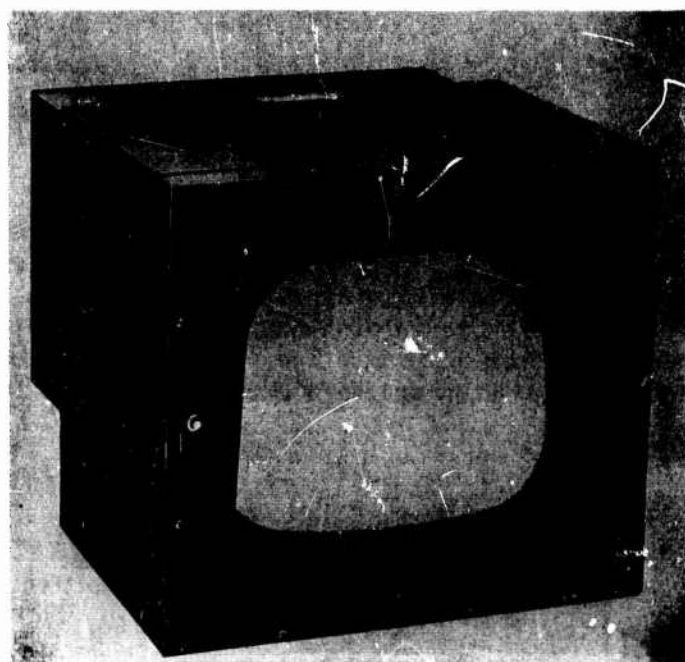


FIGURE A-14. Observer television monitor
(902 unit)

k. Pilot Television Monitor (903 unit) (Figure A-15) - Two 903 units are used in the AN/ASQ-132 system. One is located in front of the pilot and the other in front of the copilot. Each unit has an 8-inch screen. Clamps for holding the filters are located around the screen. All controls are in a housing at the top front of the unit; premission controls are behind the removable captive cover. Electrical circuitry is mounted on four cards and on the unit chassis. Circuits are accessible by removing the cover over the top and right side of the rear portion of the unit. The electrical circuits are cooled by a blower on the chassis. Four electrical connectors and a fuse are located on the rear of the unit.

l. Searchlight (904 unit) (Figure A-16) - Two 904 units are a part of the AN/ASQ-132 system. Each is housed in a cylindrical metal

case. The window of the searchlight incorporates a pink filter. The electrical connector for the 904 unit is located on top of the housing and allows a ± 5 degree adjustment in both azimuth and elevation. A blower draws cooling air into the unit through a port in the housing near the rear and exhausts through a port on the opposite side.

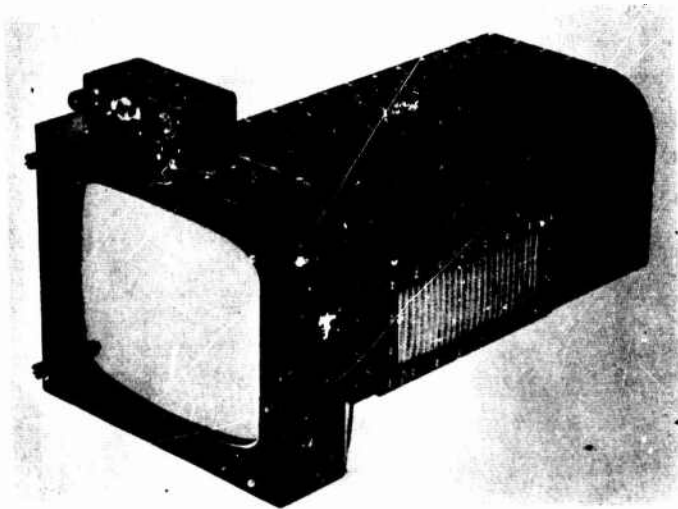


FIGURE A-15. Pilot television monitor
(903 unit)

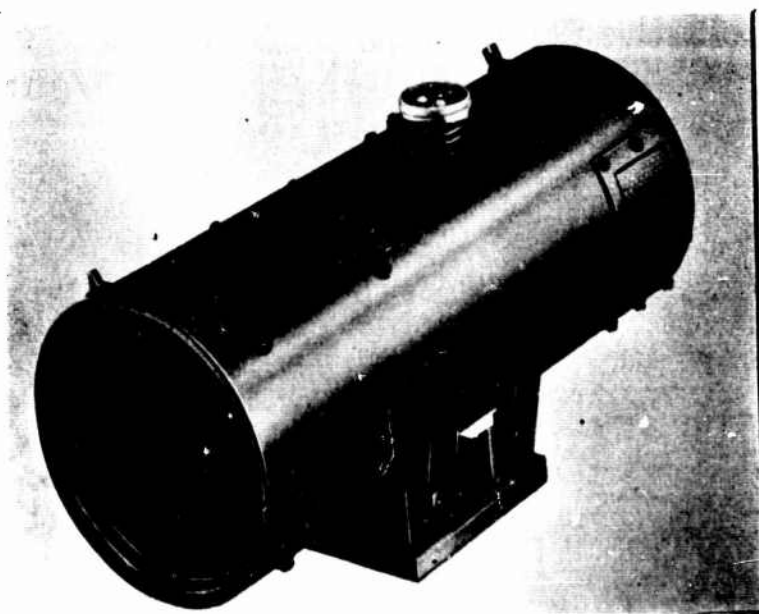


FIGURE A-16. Searchlight (904 unit)

m. Searchlight Junction Box (905 unit) (Figure A-17) - The 905 unit is housed in a metal case. The top of the case is removable to provide access to the electrical circuits inside. One end of the case contains two electrical connectors, two fuse holders and the blower. The other end of the case contains two electrical connectors and the inlet port for cooling air. Both ends of the case have two mounting flanges on the bottom side.

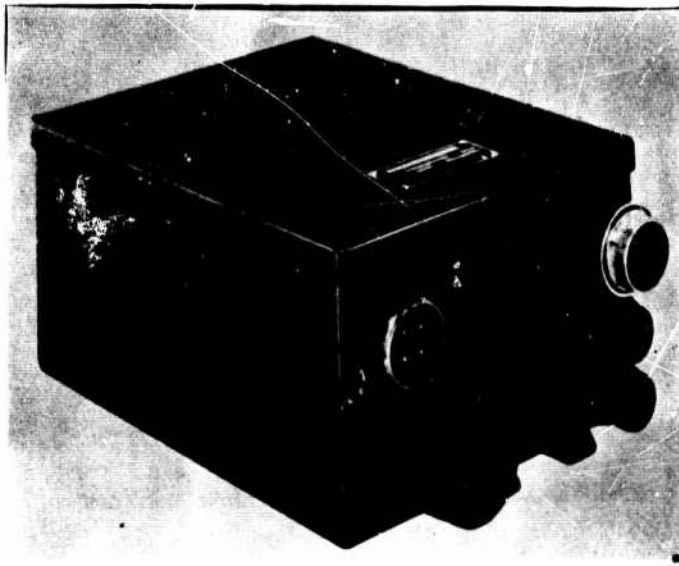


FIGURE A-17. Searchlight junction box
(905 unit)

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APPENDIX B

RULES OF ENGAGEMENT - AIR OPERATIONS

1. (U) **PURPOSE.** This annex defines specific operational restrictions and rules of engagement for US rotary wing and fixed wing aircraft in the RVN.

2. (C) **GENERAL.**

a. All targets selected for an air attack will be approved by the province chief directly or through higher RVN authority. Air attacks in specified strike zones (SSZ) may be conducted without additional GVN/RVNAF clearance only after notifying the appropriate US/FWMAF military clearance authority.

(1) The force commanders/SA, IV CTZ in their respective CTZ (or their authorized representatives) are the military clearance authorities.

(2) The ARVN corps commander in each CTZ has the authority to designate, suspend temporarily, or cancel a specified strike zone. Notifications of SSZ designation, temporary suspension, or cancellation will be originated by the ARVN corps commander (for US/FWMAF through US command channels) to all commands operating in the CTZ, with a minimum of 72 hours notification in advance of a change in status. Requests for SSZ designation, temporary suspension, or cancellation will be submitted to the ARVN corps commander via appropriate command channels.

b. All pilots will endeavor to minimize noncombatant casualties and civilian property damage. Air attacks will not be executed where identification of friendly forces is in doubt.

c. All pilots will have knowledge of the disposition of friendly forces and/or civilians prior to initiating an air attack. This information may come from ground or air briefing.

d. For purposes of this directive, references to the forward air controller (FAC) also encompass and apply to the Marine Tactical Air Coordinator Airborne (TACA).

e. USAF, USMC, and USN strike aircraft will normally be controlled by the following in the order of preference as listed:

* (1) US Air Force ALO/FAC or Marine TACA/FAC.

* (2) VNAF FAC/FAO.

(3) USAF MSQ-77 (SKY SPOT) or USMC TPQ-10.

* Under VFR conditions, when a USAF, USMC, or VNAF FAC is not available, a qualified Army Target Identifying Pilot (TIP) may designate the target to be struck and the flight leader of the strike aircraft will control the strike. The supported ground commander will acknowledge clearance for a TIP directed strike.

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GROUP 4
DECLASSIFIED AT 3 YEAR INTERVAL
DECLASSIFIED AFTER 12 YEARS

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f. Commanders of units assigned armed helicopters and strike aircraft will insure that records of ordnance expended are maintained a minimum of three months. Records will include as a minimum:

- (1) Type and amount of ordnance expended on each target.
- (2) Coordinates of target.
- (3) Date and time of initial and final engagement of the target.
- (4) Unit supported.

g. In an emergency, when compliance with the provisions of paragraph 2e, above, is not possible, the following personnel may designate the target for strike aircraft:

- (1) The commander of a ground unit or US advisor engaged with enemy forces.
- (2) The US/FWMAF pilot of an airplane or helicopter supporting a ground unit, who has radio contact with the ground unit involved and can identify friendly positions in relation to enemy positions.
- (3) The US/FWMAF/RVNAF pilot of an airplane or helicopter required to operate within the vicinity of a hostile village or hamlet for the purpose of conducting medical evacuation or supply missions, and where enemy fire presents an immediate threat to the lives of the helicopter or transport crew.

h. Villages and Hamlets. Fixed wing aircraft close air support missions that involve strikes on hamlets or villages must always be controlled by a FAC and be initiated only after US/GVN/RVNAF clearance has been obtained. Armed helicopters involved in air attacks on hamlets and villages must always be in direct radio contact with the designated control agency of the responsible ground commander. The decision to conduct such air operations must also be approved by the attacking battalion ground task force or higher commander.

(1) If the attack on a village or hamlet from which enemy fire is being received is deemed necessary, and is executed in conjunction with a ground operation involving movement of ground forces through the area, and if in the judgement of the commander his mission would be jeopardized by such warning the attack may be made without warning.

(2) If the attack on a village or hamlet is not in conjunction with any immediate ground operations, the inhabitants must be warned by leaflets and/or loudspeaker system prior to the attack and must be given sufficient time to evacuate the area. Once the inhabitants of a pre-planned target area have been adequately warned that the area has been selected as a target and given sufficient time to evacuate, the hamlet/village may then be struck without further warning.

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i. Urban Areas. Air attacks directed against known or suspected VC/NVA targets in urban areas must preclude unnecessary destruction of civilian property and must by nature require greater restrictions than the rules of engagement for less populated areas. Therefore the following specific US/GVN/RVNAF clearance procedures and restrictions must be strictly adhered to:

(1) Air attacks directed against urban areas must always be controlled by a FAC and be initiated only after US/GVN/RVNAF clearance has been obtained. The decision to conduct air attacks in urban areas will be retained at corps/field force level. Approval must be obtained from both the corps commander and the US field force level commander. This approval is required for all US air attacks to include those in support of RVNAF.

(2) The exception to this policy is the built up areas of Saigon/Cholon/Gia Dinh City. CG, II FFORCEV is authorized to delegate authority to CG, CMAC for employment of US tactical air and armed helicopters in the built up areas of Saigon/Cholon/Gia Dinh City. No further delegation is authorized.

(3) Prior to subjecting urban areas to air attack, even when fire is received from the area, at least one of the following means will be used to warn the civilian population and to obtain their cooperation and support: leaflets, loudspeakers (air or ground) or notification through the appropriate civilian clearance authority or US/FWMAF military commanders.

(4) The use of incendiary type munitions will be avoided unless destruction of the area is unavoidable and then only when friendly survival is at stake.

3. (C) SPECIFIC INSTRUCTIONS FOR CLOSE AIR SUPPORT TO INCLUDE INTERDICTION (DAY OR NIGHT).

a. ALO/FAC will:

(1) Have thorough knowledge of the ground scheme of maneuver.

(2) If possible, secure a VNAF FAC or RVNAF observer to assist in directing an air strike when in support of an ARVN unit. If a RVNAF observer is not available, an ALO/FAC is authorized to direct the air strike.

(3) Maintain reliable communications with the ground unit and strike aircraft.

(4) Make positive identification and mark the target. COMUSMACV may waive the marking requirement in the case of specially equipped aircraft.

(5) Insure that strike pilots are aware of friendly locations in relation to target, characteristics of target area, and local weather conditions.

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(6) Use 1:50,000 or larger scale maps of target area, and photographs when available.

b. Pilots of strike aircraft will:

(1) Always be under the control and in direct radio contact, for a strike, with a FAC or designated control agency, airborne or ground.

(2) Have visual contact with target or target marker.

(3) Always ascertain the position of friendly troops (or civilians, when applicable).

(4) Ascertain local conditions regarding weather, target area, and surrounding terrain characteristics.

(5) Defend themselves against ground fire providing:

(a) Source of fire can be visually identified.

(b) The strike can be positively oriented against the source.

(c) The fire is of such intensity that counter-action is necessary.

(6) Utilize artificial illumination for night strikes

(7) A waiver may be granted for specifically equipped aircraft (i.e. TRIM, DIANE, TROPIC MOON, etc.), of these requirements stipulated in paragraph 3b(1), (2), and (6), above. Waivers will be granted by COMUSMACV on a case-by-case basis only.

4. (C) BORDER RESTRICTIONS FOR AIRCRAFT CONDUCTING ASSIGNED MISSIONS IN THE RVN.

a. US/FWMAF military fixed wing and rotary wing type aircraft will not cross the demilitarized zone or Cambodian border unless specifically authorized by COMUSMACV.

b. All FAC operating in the vicinity of the border will have a 1:50,000 or larger scale map of the target area (e.g. 1:25,000). Maps, mosaics, and photographs will be made available to the pilots.

c. Joint operations-intelligence facilities will be established and complete pre-strike briefings and post-strike debriefings will be conducted for strikes within 5,000 meters of the border, when practical.

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d. Cambodian border restrictions which are additional to the above:

(1) Strike aircraft within 5,000 meters of the Cambodian border will be under positive control of a FAC or MSQ-77/TPQ-10. The authority to waive this requirement is restricted to COMUSMACV or his designated representative.

(2) All organizations responsible for planning or execution of missions within 5km of the border will have posted in operations a 1:250,000 or larger scale map on which the Cambodian border is distinctly marked, on the RVN side, to the depth of 5 km. In addition, aircraft crews operating in close proximity to the Cambodian border will be briefed on the provisions of regulations relating to border operations and will have in their possession a suitable map which accurately portrays the border and the buffer zone.

(3) Aircraft supporting border outposts (fire support, reconnaissance, supply, and transportation) are allowed to operate as necessary in the outpost area, but will neither cross nor fire across the border.

(4) Appropriate radar stations will flight follow aircraft on missions within 5 km of the border within equipment capability.

5. (C) RELIGIOUS MONUMENTS AND PUBLIC BUILDINGS.

a. The enemy has shown by his actions that he takes advantage of areas or places normally considered as nonmilitary target areas. These areas are typified by those of religious background or historical value to the Vietnamese. Where it is found that the enemy has sheltered himself in places of worship such as churches and pagodas or has installed defensive positions in public buildings and dwellings, the responsible senior brigade or higher commander in the area may order an air attack to insure prompt destruction of the enemy. The responsible commander must identify positive enemy hostile acts either in execution or preparation. Weapons and forces used will be those which will insure prompt defeat of enemy forces with minimum damage to structures in the area.

b. The exception to this policy is the palace compound in the Hue Citadel. For this specific area, commanders should consider the employment of massive quantities of CS crystal.

6. (C) JETTISON.

a. Munitions will be jettisoned only in designated jettison areas.

b. During night or IFR conditions, aircraft will be under positive radar control while jettisoning, except during emergencies covered in paragraph 6d below.

c. During day VFR, drops will be monitored by radar whenever possible.

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d. Aircraft may jettison munitions in other than designated areas during emergencies when there is an immediate threat of injury to the crew or damage to the aircraft. Every effort will be made to insure that munitions are not jettisoned so that they impact into or near inhabited areas.

7. (C) SPECIFIC INSTRUCTIONS FOR ARMED HELICOPTER ENGAGEMENT.

a. US Army, US Marine, US Air Force, and US Navy armed helicopters will be marked "US Army", "US Marine", "US Air Force", or "US Navy" as appropriate.

b. For the purposes of this directive, an armed helicopter is defined as any helicopter that has mounted an ordnance delivery system.

c. Fire only when all three of the following requirements are satisfied:

(1) In direct radio contact with and under the control of the designated control agency of the responsible ground commander.

(2) The target or target marker can be visually identified.

(3) Friendly and civilian positions are positively identified.

d. Urban areas will be attacked only when directed by the responsible ground commander and then in accordance with the rules set forth in paragraph 2i of this annex with the exception of the FAC requirement. Such attacks when so directed will be governed by the restrictions set forth in paragraph 7c, above. Further, only point targets (i.e. specific buildings) will be engaged and these targets must be positively identified to the pilot. The engagement of area targets in urban areas is prohibited.

e. Targets of opportunity acquired in a specified strike zone may be engaged anytime after notifying the appropriate US/FWMAF/RVNAF clearance authority.

f. Ordnance delivery systems in armed helicopters will be fired only when authorized by the aircraft commander.

g. Airborne test firing of weapons will be conducted only after obtaining permission from the appropriate clearance authority.

h. Pilots of helicopters are permitted to defend themselves against ground fire anytime providing all three of the following requirements are satisfied:

(1) The source of fire can be visually identified.

(2) The attack can be positively oriented against the source.

(3) The fire is of such intensity that counter-action is necessary.

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8. (C) AIR RECONNAISSANCE AND AERIAL SURVEILLANCE MISSIONS.

a. Reconnaissance aircraft operating near the RVN/Cambodian border are not allowed to cross the border and penetrate Cambodian airspace.

b. Aerial reconnaissance flights along or near the Cambodian border are vital to the security of the RVN and US defense efforts. However, extreme care must be exercised in planning and executing in-country missions by reconnaissance aircraft of all services to insure that inadvertent overflights do not occur.

c. US Army aircraft may be armed with target marking ordnance while on surveillance missions.

9. (U) AIR TO AIR RESTRICTIONS. Commander, 7th Air Force, prescribes rules of engagement and restrictions for air to air combat in the RVN. These are published by that headquarters in Tactical Air Control Center (TACC) Operating Instructions (OI) No. 55-33, 30 Mar 66.

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APPENDIX C

EQUIPMENT PROVIDED WITH ELECTRONIC SHOP VAN, AN/ASM-189

1. EQUIPMENT LIST (LESS VAN COMPONENTS)

<u>UNIT</u>	<u>FEDERAL STOCK NUMBER OR MANUFACTURER'S PART NO.</u>
a. Digital voltmeter (Non-Linear System X-1)	6625-168-0669
b. Voltmeter ME-227/U	6625-555-2312
c. Oscilloscope AN/USM-32	6625-519-1954
d. Voltmeter ME-147/U	6625-557-5672
e. Multimeter TS-352/U	6625-553-0412
f. Counter. electronic digital readout	6625-044-3228
g. Oscilloscope AN/USM-140C	(140A) 6625-999-3592
h. Oscillator test set (HPG51B)	6625-937-4961
i. Pulse generator (Hewlett Packard)	HP8003A
j. DC power supplies (Hewlett Packard)	1 ea. HP6217A 1 ea. HP6207B 1 ea. HP6202B 5 ea. HP6215A
k. Sync. generator & bar-dot generator (Cohu Electronics, Inc.)	2472-511
l. Oscilloscope (Tektronix 453)	6625-930-6637
m. Purging kit	4931-065-1110
n. Nitrogen, bottled	6830-264-9086
o. Flight line test kit, INFANT (Hughes Aircraft Company)	3167950
p. Viewer test kit, INFANT (Hughes Aircraft Company)	3166031-100
q. Tool kit TK-100/G	2 ea. 5180-605-0079

<u>UNIT</u>	<u>FEDERAL STOCK NUMBER OR MANUFACTURER'S PART NO.</u>
r. Electronic tool kit TK-105/G	2 ea. 5180-610-8177
s. Towbar, aircraft (modified)	1730-967-9556 (Basic)
t. Desoldering/resoldering iron, 300 MD-K	3439-907-5806
u. Electrical power generator, JHDW45KW	6115-075-9122
v. Miscellaneous hardware.	

2. FLIGHT LINE TEST KIT

The special test equipment supplied for the maintenance of the AN/ASQ-132 included a flight line test kit. The kit is made up of the several components illustrated in Figure C-1.



FIGURE C-1. Flight Line Test Kit

a. Stabilization Amplifier Test Adapter, 3167931 (Item No. 1). This is used to provide a breakout of test points for connector J-4 on the 009 (electronic stabilization control amplifier) unit. The J-4 connector serves the purpose of making signals available for testing purposes.

b. TV Monitor Extension Cables No. 1, 3167938, and No. 2, 3167939, (Item No. 2). These cables allow the TV monitors to be removed from their normal location in the helicopter and continue to operate as part of the system. This aids in troubleshooting and making adjustments to components not otherwise accessible when the monitors are installed.

c. Stabilization Amplifier Test Cable, 3167932 (Item No. 3). This cable allows interchange of the DV and RV servo power circuits in the A-11 assembly in 009 unit.

d. Turret Electronics Test Adapter, 3167930 (Item No. 4). This item is used to monitor image motion compensation (IMC) transformation outputs which are not available elsewhere. It also permits access to certain buffered outputs of other signals needed in troubleshooting.

e. AN/ASQ-132 Control Panel Extension Cables No. 1, 3167936, and No. 2, 3167937, (Item No. 5). These cables are used to operate the 012 unit when removed from its helicopter pedestal location, thereby enabling necessary operational adjustments. Some AN/ASQ-132 systems do not require this item, as self-contained cables on the 012 unit are long enough to permit removal from the pedestal.

f. Stabilization Amplifier Extension Cables No. 1, 3167933, and No. 2, 3167934, and No. 3, 3167935, (Item No. 6). These cables are used to allow the 009 unit to operate outside the confines of its normal compartment location. This is an aid during troubleshooting and boreighting procedures.

3. PERISCOPE PURGING KIT



The periscope purging kit consists of the normal control valve, gauge, and hose necessary for use with gas bottled under pressure. In addition, a steel plate (see Figure C-2) was furnished for use over the glass faceplate of the turret during purging operations. The plate serves as a safety device in the event the faceplate were to shatter while under the nitrogen pressure required for purging.

FIGURE C-2. Periscope Purging Kit

4. USAGE

The oscilloscope, multimeter, digital voltmeter, high voltage meter, bar generator, and AN/ASQ-132 breakout test boxes were utilized in the direct support level of maintenance. General support maintenance utilized DC power supplies ranging from 25 to 160 volts, an oscillator, a digital readout counter, and test boxes that were made by the MET Team. Also supplied were two TK 100 and two TK 105 electronic tool kits and an assortment of wire and miscellaneous hardware.

APPENDIX D

SPECIAL ITEMS AND FIELD FABRICATED TEST EQUIPMENT

Special test equipment was fabricated and procured by the contractor's field service representatives and NETT personnel to facilitate maintenance operations and troubleshooting. The items and their intended purposes are listed below. A photographic illustration (Figure D-1) is included to assist in identification.

a. Low Voltage Power Supply (LVPS) Test Adapter. This adapter is used to test the LVPS (010 unit) without having to mount it in the AN/ASQ-132. It enhances a technician's ability to study a failure on a bench in the van, where all necessary test equipment is close at hand. The adapter has shunts for all outputs and can be used on a working system to measure all output currents fed to the AN/ASQ-132. This adapter can also be used in conjunction with a spare LVPS and the card test adapter to provide the required voltages for card testing in the van.

b. 008/009 Unit Card Test Adapter. This test box is used to check defective 008 (signal data processor) and 009 (electronic stabilization control amplifier) unit circuit boards. The card undergoing test is inserted in the card socket. All connections for input or output are brought out as numbered test points. Power and signals can also be put into the card to locate failed components.

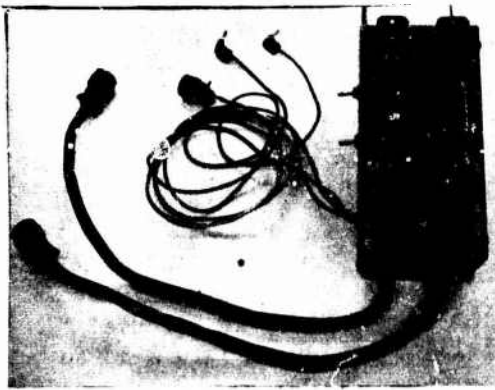
c. Periscope (Turret) Test Adapter. This adapter is used for testing certain mechanical functions of the 006 (RV tracking periscope) or 004 (DV tracking periscope) units. It also serves as an important aid in DV camera alignment by permitting the half periscope assemblies to be cradled in a convenient position for mechanical repair in the van. The functions that can be simulated with this adapter include: opening and closing of shutters; release of azimuth, elevation, and camera de-rotation brakes; focusing of lens; opening and closing of the RV iris, and monitoring the iris position.

d. TV Monitor Card Extenders. The picture illustrates three extenders: TV monitor card extender, 012 (system control panel) unit extender, and 009 (electronic stabilization control amplifier) unit extender. A personally acquired "tri-ax to BNC co-ax" adapter is also shown. The extenders are used to extend a unit card from its normal position in the unit. This permits easy access to components on the card and assists in troubleshooting. The "tri-ax to co-ax" adapter is used to extract a usable test signal from the 008 (signal data processor) unit that is compatible with available test equipment.

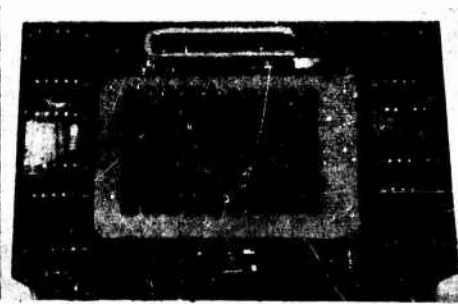
e. Special Purpose Tools

(1) Vernier Calipers - Used in determining shims required for camera and gear box.

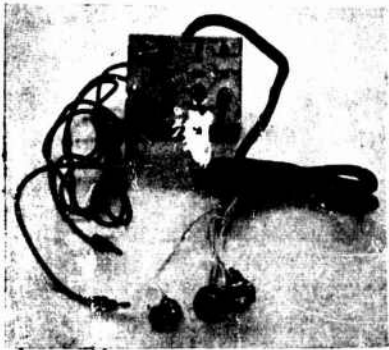
(2) Bourn's Triopot and JFD Adjustment Tools, 5284 - Used for



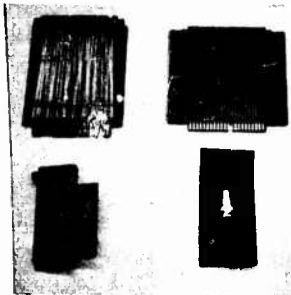
LVPS Test Adapter



008/009 Unit Card Test Adapter



Half Turret Test Adapter



TV Monitor Card Extenders



Special Purpose Tools



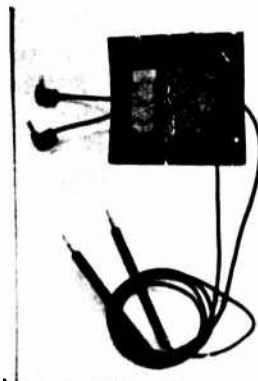
Extractors/Inserters



TV Monitor Card Test Adapter



HVPS Test Adapter



1000:1 Attenuator



Special Purpose Expendables

FIGURE 2-1. Special Items and Field-fabricated Test Equipment

adjustments on INFANT circuit boards.

(3) Jeweler's Screwdrivers - Used for adjustments and aligning.

(4) Plumb Bob - Used during boresighting for positioning and leveling of aircraft and target board.

f. Extractors/Inserters. These are used to remove and replace pins from connectors, usually to repair broken wires. The picture illustrates size 16 pin extractor and inserter, size 20 inserter and extractor, and Deutsch pin extractor and inserter.

g. TV Monitor Card Test Adapter. This test box is used to test TV monitor cards for possible failure. It functions in the same manner as item b above. The source of the cards is the only difference.

h. High Voltage Power Supply (HVPS) Test Adapter. This unit is used to run either a DV or RV HVPS in the maintenance van. It can continuously control the CATH, FOCUS, ZOOM, and 1DVAC (DV) or ANODE (RV) while permitting the function to be monitored. This unit in conjunction with the viewer test kit and the half periscope (turret) test adapter, is used in repairing and aligning a 004 (DV tracking periscope) unit, without the use of an entire AN/ASQ-132.

i. 1000:1 Attenuator. This unit is used for high voltage measurements of the 008 (signal data processor) unit A-7 card (secondary power supply). It also performs the function of impedance matching of the output voltage of the measuring device.

j. Special Purpose Expendables. These items were vital elements for performing routine maintenance.

(1) Dow Corning 3145 RTV (room temperature vulcanizing) compound - Used to waterproof seal in half turrets.

(2) Thixotropic Oil - Used in mating of fiber optic bundle to DV camera.

(3) Pure Grain Alcohol and Lens Tissue - Used to clean lens assemblies, cables from cameras, and camera faces.

(4) Thermo-Fit Sleeving - Used to cover wire splices and isolate wires on cable connectors.

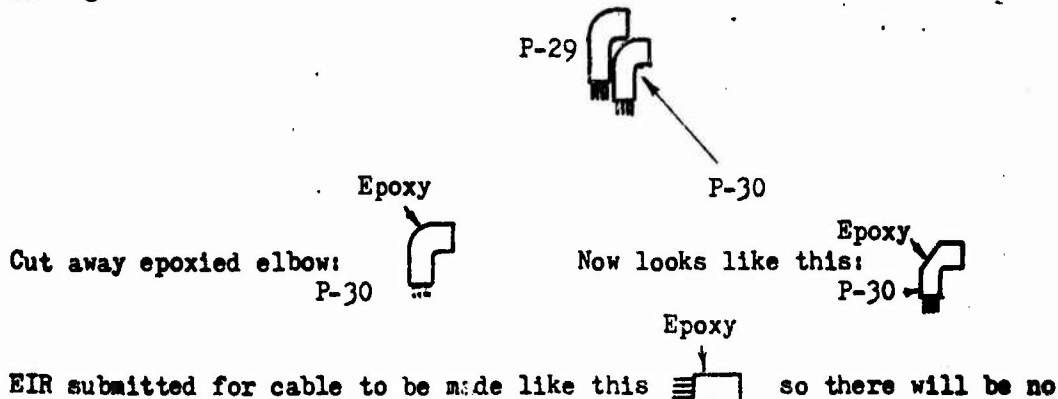
(5) Loctite (not shown) - Used on screws to secure them against vibration.

APPENDIX E

SUMMARY OF PROBLEMS ENCOUNTERED IN FIELD ASSEMBLY OF

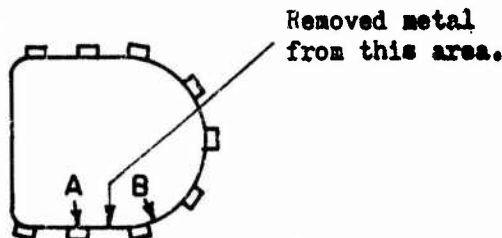
AN/ASQ-132 FROM SPARE COMPONENTS

1st Day: Started to install spares UH-1M, 66-0584. First problem noted was that the mount for the copilot's monitor was not properly manufactured. Hole in rear plate of mount through which the video cable goes to mate with monitor was 1/4 inch too far to the right. Drilled new hole for cable. Holes in mount which fastens monitor to mount were not drilled in the proper locations. The front two holes were 1/16 inch to the right of mating holes on the monitor. The left rear hole was also 1/16 inch to the right. The right rear hole was 1/8 inch to the right of mating holes on the monitor. The next problem detected was with the pilot's monitor mount. The mount itself is fastened down in the rear by four bolts; however, the second bolt from the left hits power cable J-04 and the cable can not be installed or removed unless the monitor is unbolted from the mount. Another problem occurred when trying to mount the direct view turret to the periscope assembly. Found connector P-29 could not be mated to J-19 because P-30's epoxied elbow was hindering its mating.



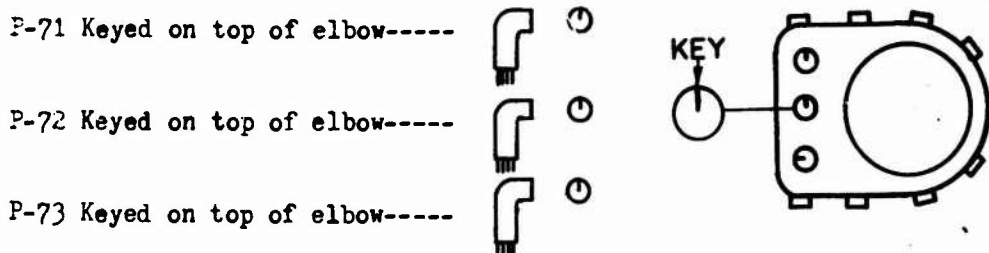
interference between P-29 and P-30. After plugs were mated tried again to install direct view turret but could not because the camera housing cover was bound between the turret and the subassembly on the bottom of assembly between point A and point B.

Cross Section

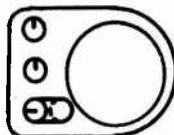


Removed the turret and filed it out 1/16 inch deep and 1/4 inch back inside of subassembly. Then tried to mount direct view turret again; no problems.

Tried to mount the remote view turret but could not because either P-73 connector or J-73 was keyed in the wrong place.



Problem was that the elbow would hit the camera housing cover and not allow it to mate with J-73.



Brought remote view turret in van so that we could turn J-73 90°.



This was quite difficult because of the location of J-73 inside of turret. Tried again to mount the remote view turret to subassembly; this time, no problems. Hooked up high voltage power supply and turned on system. No 400Hz power present.

2nd Day: Found that both inverters would come on in either toggle switch position, Main or Spare. Traced problem to K-105 relay of power relay box. K-105 was not only wired wrong but five wires were not even connected to the relay. The missing wires were discovered when checking the wiring of K-105 relay. Wire YC1010B22 was connected to X-1, should have been connected to X-2. A jumper between D-1 and X-2 should have been connected to X-2. Wires YC1017A22 and YC1014A22 were spliced together. Broke splice and put YC1017A22 to X-1 of K-105 and YC1014A22 to A-1. Wires were found tied back in bundle going to power relay box. Untied them and connected them to K-105, YC1012A22C to A-2, YC1013A22 to B-1, YC1016A22 to D-2, and YC1015A22 to D-3.

Turned system on and found remote view working fine, except the third field of view was grossly out of focus. The direct view camera derotation was going from limit to limit. No generator power.

3rd Day: Started work on direct view system to find problem with derotation. Did troubleshooting until the afternoon when a problem occurred on UH-1M 66-0511 requiring maintenance personnel.

4th Day: Continued checks on derotation problem and removed and checked the potentiometers on camera derotation assembly. Brought assembly into van for checks and alignment. Reinstalled assembly in direct view turret, derotation continued going from limit to limit. Continued troubleshooting and found that the tachometer output was not acting completely normally. Checked tachometer output at camera derotation assembly; O.K. Checked at turret electronics; O.K. Checked at 009 unit. Problem present. Started a wire check between 001 unit and 009 unit and found crimped pins, tachometer to linear potentiometer, between 009 unit cable and 009 unit extender cable. Repaired pins on cable and reconnected to 009 unit. Aligned derotation assembly potentiometers again. Hooked up assembly but did not install in turret. Checked and found that the limit to limit rotation was gone but acquired an oscillation problem with derotation motor. Derotation assembly brought back into van to check the tachometer in case the previous problem had induced another. Compared tachometer to another tachometer from spares; it checked out O.K.

5th Day: Started a visual check of wires on J-20, J-24, J-16, found that wire A, J-16 was being held in place by thermo fit sleeving and would intermittently break contact with pin causing the oscillations. Resoldered wire to pin A, J-16 and turned on system. No problem. Installed camera derotation assembly back into turret and turned on direct view system. Found direct view shutter would cycle open and closed at a 2Hz rate. Also found the sun sensor was very noisy. Overrode the sun sensor. Shutter would not open. Commenced troubleshooting; finally removed motor brake shield and applied 30 volts directly to shutter and hold. Could hear solenoid engage but shutter would not open.

6th Day: Direct view turret SN: 5 removed from AN/ASQ-132 system #4 and brought into van to have a closer look at shutter problem. Started alignment of remote view system according to alignment procedures in POMM 11-5855-208-34/1 Dec 69. During alignment of protection circuits, no video signal was being supplied to the A-13 card in the 008 unit. Started troubleshooting, ending up back at pin 4 of the A-1 card. Found that there was conformal coating on pin 4 preventing it from making contact with card rack assembly. Removed conformal coating from pin 4 and inserted card back in 008 unit and found signal present at pin 5 A-13 card. Continued the alignment of remote view system and completed it.

During the remote view alignment process, direct view turret SN: 3 was cannibalized from system #3 on UH-1M, 66-0703. It was removed and reinstalled on 66-0584 to complete system #4. After completing the remote view alignment, started on the direct view alignment; no problems occurred with the direct view system.

7th Day: Repaired broken wire V-1 on the turret electronics box and purged the remote view turret. Aligned gun pots on M6 sighting station. After a 3-hour purging of the remote view, installed the high voltage

power supply and turned on both systems. Everything checked out fine.

Lined helicopter center line with center line of boresight board and leveled helicopter to check out the M60 and M6 Sighting Station. Shimmied and lined up the M6 Sighting Station under supervision of Hughes Aircraft technical representative. Rewired and lined up the M60 Pilot's Sight.

8th Day: Commenced boresight of system #4 (66-0584) and had a problem with the left gun. Checked left hand gun pot output and found it to be intermittent at K-2 on the A-7 card of the 009 unit. Replaced A-7 card SN: 7 with A-7 card SN: 5 and completed boresight. Towed 66-0584 to flight line so that the blades could be tracked and ship test flown. When ship came back from test flight we were informed that INFANT would not operate on aircraft power. Found that aircraft relay K-4 contacts D-1, D-2, and D-3 were miswired. Rewired K-4 correctly and turned system on using aircraft power; INFANT system checked out fine.

INFANT system #4 went on first mission that night (4 Feb 70).

Summary of man hours utilized:

Installation:	6 men 10 hours (60 man-hours) to install INFANT properly
K-105:	4 men 10 hours (40 man-hours) to correct
Derotation problems:	4 men 30 hours (120 man-hours to correct
Systems Alignment:	2 men 10 hours (20 man-hours)
Armament Alignment:	3 men ten hours (30 man-hours)
Boresight:	4 men 3 hours (12 man-hours)
K-4:	4 men 2 hours (8 man-hours).
Total man-hours:	290.

APPENDIX F

MISSION PROFILES

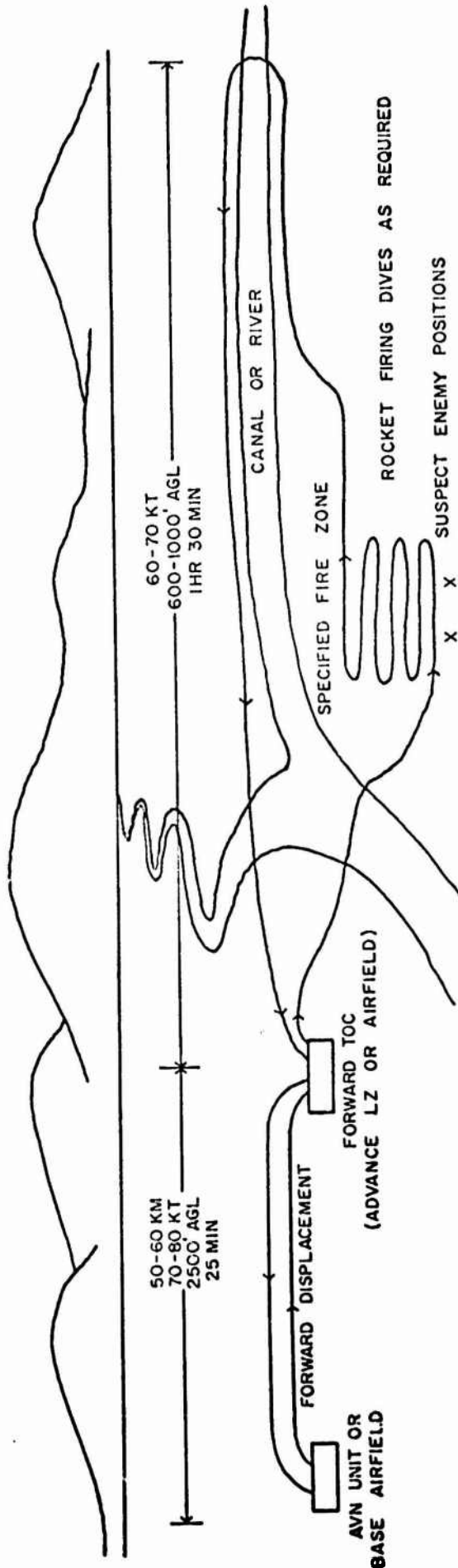
IROQUOIS NIGHT FIGHTER AND NIGHT TRACKER

GENERAL CRITERIA

1. Crew: Pilot, copilot/gunner, crew chief/door gunner, and door gunner.
2. Basic Navigational Equipment: Standard UH-1M avionics for SEA, less AN/ARC-102.
3. Basic Communications Equipment: Standard UH-1M avionics for SEA.
4. Weapons Delivery System: M21 Armament Subsystem.
5. Surveillance System: Image Intensifier System, Night Vision, AN/ASQ-132.
6. Survivability: High in low intensity warfare (stability operations).
7. Target Description: Point targets, area targets, and suspect zones.
8. Target Detection and Recognition: Visual observation on display.
9. Target Destruction: By use of on-board M21 armament subsystem.
10. Mission Modes: See mission sheets (Figure F-1 and Figure F-2).
11. General and Subsystem Equipment: Items 4 and 5 above, Formation Lights, two M60 machine guns, and crew survival equipment.
12. General Comments:
 - a. The figures for % of TOTAL MISSIONS are based on experience during a 90-day combat evaluation in RVN. Further use of operational quantities may alter types of missions flown and the percent of total missions for each type.
 - b. The M60 Machine Guns are used as door guns, primarily for aircraft self-defense.
 - c. Aircraft maneuvers are somewhat sluggish, due to high gross weights encountered during mission loading.
 - d. The pilot and copilot/gunner are provided with a display that permits viewing the area of interest under nighttime visual meteorological conditions.

e. There is no self-contained navigation system provided for navigation without the aid of ground stations; hence, the INFANT system is limited in position location capability.

f. Direct communication between systems, other aerial weapons, artillery, illumination systems, and command and control elements is provided by standard Army aircraft avionics.



MISSION TYPE: Surveillance/Reconnaissance
% OF TOTAL MISSIONS: 95%

FLIGHT DURATION:

1st Segment - 25 min
2nd Segment - 1 hr 30 min
(Repeatable)
Last Segment - 25 min.

MISSION: LOADING: Aircraft crew of four; 5400
rd 7.5 mm; 14 2.75" FFAR; survival equipment.

% OF MISSION TIME PER FLIGHT PHASE:

En route - 18% (Excluding forward displacement)
Surveillance/Reconnaissance - 82%.

NUMBER OF LANDINGS:

Five - based upon 2 en route sorties and
three survl/recon sorties.

SEVERE FLIGHT MANEUVERS:

Steep Turns - execute evasive maneuvers when
under fire and during break from firing runs.

% EXPOSURE TO RESTRICTIVE OPERATING CONDITIONS:

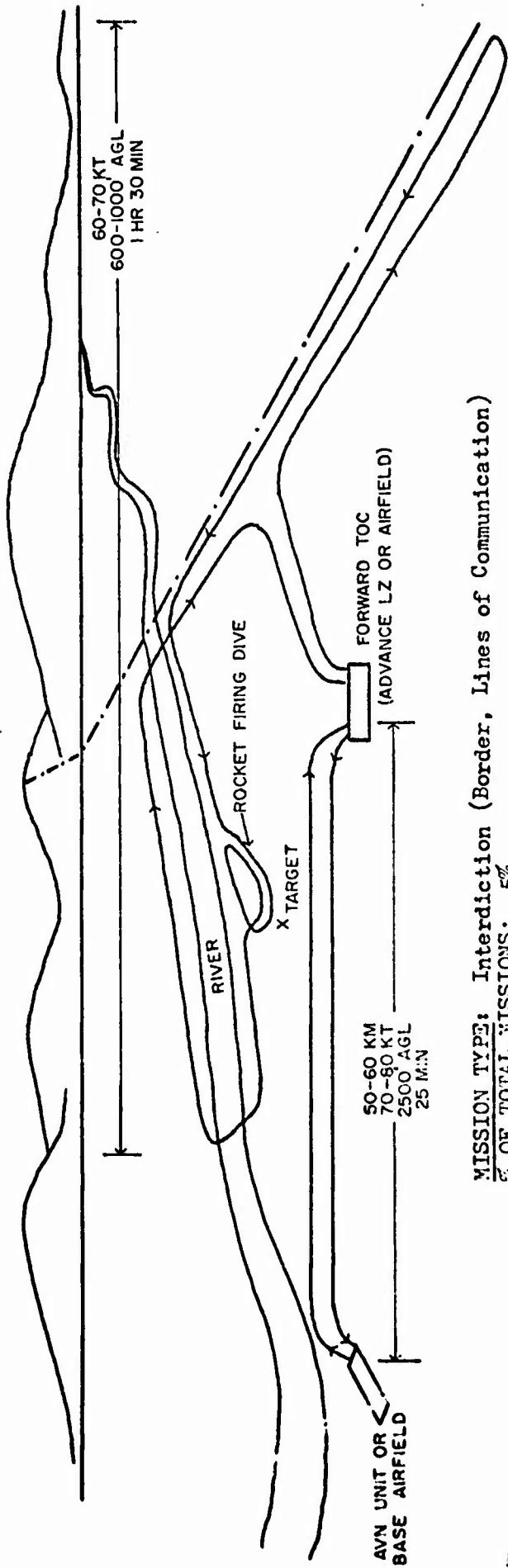
100% of missions flown are at night.

FIRING DATA:

M21 { 2250 rounds per M134 gun (2)
7 rockets per XM158 launcher (2)
M60 - 450 rounds per gun
Sighting and Fire Control of M21 through AN/ASQ-132
image intensification by direct view and remote view
displays.

COMMENTS: Two INFANTS may be employed as a fire team.
Area, zone, or point armed reconnaissance or surveillance.
Copilot/Gunner scans area with direct view sensor. Pilot
operates aircraft and scans area with remote view sensor.
Chase UH-1H also accompanies as command and control and
provides crew recovery when necessary.

FIGURE F-1. Mission Profile, Surveillance/Reconnaissance (95% of Total Missions)



MISSION TYPE: Interdiction (Border, Lines of Communication)
 % OF TOTAL MISSIONS: 5%

FLIGHT DURATION:

1st Segment - 25 min
 2nd Segment - 1 hr 30 min
 (Repeatable)
 Last Segment - 25 min.

MISSION LOADING: Aircraft crew of four; 5400
 rd 7.62mm; 14 2.75" FFAR; survival equipment.

% OF MISSION TIME PER FLIGHT PHASE:

En Route - 18% (Excluding forward displacement)
 Surveillance/Reconnaissance - 82%.

NUMBER OF LANDINGS:

Five - based upon 2 en route sorties and
 three survl/recon sorties.

SEVERE FLIGHT MANEUVERS:

Steep Turns - execute evasive maneuvers when
 under fire and during break from firing runs.

FIGURE F-2. Mission Profile, Interdiction of Borders or Lines of Communication (5% of Total Missions)

% OF EXPOSURE TO RESTRICTIVE OPERATING CONDITIONS:
 100% of missions flown are at night.

FIRING DATA:

M21 { 2250 rounds per M134 gun (2)
 7 rockets per XM158 launcher (2)
 M60 - 450 rounds per gun
 Sighting and Fire Control of M21 through AN/ASQ-132
 image intensification by direct view and remote view
 displays.

COMMENTS: Two INFANTS may be used to alternate on-
 station for continuous coverage. Copilot/gunner scans
 close in and to flanks with direct view sensor. Pilot
 operates aircraft and scans ahead with remote view
 sensor. Chase UH-1H also accompanies as command and
 control and provides crew recovery when necessary.

APPENDIX G

INFANT CREW DRILL

1. Aircraft commander briefs crew on mission and checks each member to ensure that equipment necessary for flight is present.
2. Gunner and crew chief check M21 system for safety prior to preflight inspection.
3. Gunner unties rotor blades and gunner and crew chief remove searchlight covers.
4. Gunner secures fire extinguisher from aircraft, crew chief secures auxiliary fire extinguisher, and both post to aircraft engine area for start.
5. Engine start and run-up (use UH-1 check list). Fire extinguisher is returned to aircraft after start.
6. INFANT check (use AN/ASQ-132 check list). Gunner and crew chief stand clear of M21 system.
7. INFANT periscope filters are removed after check completed and the stray-light visors are installed and safetied. Filters placed in helicopter.
8. Crew chief secures all equipment in main cabin compartment.
9. Gunner arms M21 system, ungrounds the rocket tubes, signals to the aircraft commander that the system is armed, and enters helicopter.

SHUT DOWN AFTER LANDING

1. Aircraft commander rechecks armament circuit breakers in OUT position and selector switch in OFF position.
2. Gunner exits helicopter, unarms the M21 system and grounds the rocket pods.
3. Crew chief exits helicopter.
4. Stray-light visors are removed from periscopes and filters are installed. Searchlight covers are replaced.
5. Gunner ties down rotor system when blades stop turning.

6. Aircraft commander holds crew debriefing and releases crew for preparation for the next mission.

AN/ASQ-132 OPERATIONAL CHECK LIST

PREFLIGHT:

1. Check that all AN/ASQ-132 circuit breakers are in (located in battery compartment).
2. Check for physical damage to searchlights and periscope assembly, and that the surrounding area permits their movement.
3. Check that neutral density filters are in place during daylight operation and removed during nighttime operation. Inspect filters for light leaks.
4. Check that searchlight covers are on or off as desired.

PRESTART COCKPIT CHECK:

1. Check that the following AN/ASQ-132 controls are in the positions indicated:

SRCH-LTS	-	OFF
MAN IRIS	-	SHTR (not REL)
FOV	-	WIDE
RV	-	STICK
ALC LEVEL	-	fully counterclockwise

2. Check that monitor ON-OFF switches are ON.

RUN-UP:

1. Check that INVTR switch on overhead acft power panel is in MAIN position after engine is started.
2. Check that STARTER GEN switch is in STBY GEN after engine is started.
3. Check that G.E. GUN CONT CIRCUIT breaker is in (all other M21 circuit breakers are out).
4. Set M21 OFF/SAFE/ARMED switch to SAFE.
5. Press DV MODE (STOW lights). Press DV MODE again (OPER lights). DV periscope should track with M6 sight after 20 seconds.

6. Observe if SHUTTER is lighted. Adjust DV eyepiece BRIGHTNESS toward operator until SHUTTER extinguishes.
7. Observe image through eyepiece; check and adjust BRIGHTNESS.
8. Check DV eyepiece focus and FOV capabilities.
9. Press RV MODE (OPER, WARM-UP, and SHUTTER should light) WARM-UP will extinguish in 30 seconds (10 seconds if DV is already on).
10. Check for calibration pulse and crosshairs on monitor. Do not proceed if they are not present.
11. Check RV periscope tracking with RV hand control.
12. Set RV switch to M6. DV periscope, RV periscope, and searchlights (guns) should track with M6 sight.
13. Set RV switch to IR AIDED. RV periscope and searchlights (guns) should track with RV hand control.
14. Check for calibration pulse on monitor. Do not proceed if it is not present.
15. Rotate vernier fully counterclockwise (SHUTTER extinguishes) and set MAN IRIS switch to SHTR REL.
16. Adjust MAN IRIS toward HI for good image. Rotate vernier as fine-tune.
17. Observe image on monitor. Adjust and check monitor CONTRAST and BRIGHTNESS controls for best display.
18. Set MAN IRIS switch to ALC. Adjust ALC LEVEL for best image.
19. Check for focus and FOV capabilities.
20. Press DISCH. Observe that monitor blanks and recovers within 2 seconds after release of DISCH.

WARNING

Before energizing searchlights, ensure that no personnel are in the beam path. Do not check for searchlight operation by looking at the beam.

21. Set SRCH-LTS to BOTH. Feel housings for warmth.
22. Set SRCH-LTS to RT. Feel housing for warmth.
23. Set SRCH-LTS to LT. Feel housing for warmth.

24. Set SRCH-LTS to OFF.

PRETAKE-OFF AND PRELANDING:

1. Press DV MODE to obtain STOW indication.
2. Press RV POS to obtain STOW indication.
3. Set M21 OFF/SAFE/ARMED switch to OFF.
4. G.E. GUN CONT circuit breaker out.

SHUTDOWN:

1. After DV periscope has reached stow position, press DV PWR OFF.
2. After RV periscope has reached stow position, press RV PWR OFF.

APPENDIX H

INFANT NEW EQUIPMENT TRAINING TEAM PROGRAM OF INSTRUCTION

AVIATOR/OPERATOR TRAINING

1. Purpose: To qualify in-country aviators in operation of the INFANT system.
2. Scope: The total course requires 55.2 hours broken out as follows:
 - a. Classroom instruction - 29.7 hours.
 - b. Flight instruction - 25.5 flying hours per student.
 - (1) 10.5 hours day with filter
 - (2) 15.0 hours night.*

3. <u>Class Room Instruction</u>	<u>Hours</u>
Introduction	1.0
INFANT Indoctrination	1.0
Operation of Direct View Subsystem	1.0
Operation of Remote View Subsystem	1.0
Circuit Breakers and Fire Control	1.0
Aerial Rocketry	1.0
Preflight and Emergency Procedures	9.0
M134 Minigun	2.7
INFANT Operations	1.5
Capabilities and Limitations	2.8
Armament Loading Procedures	1.5
Tactical Briefing Procedures	2.0

*Ammunition to be expended per student:

2.75 rockets - 63 rounds

7.62mm (dim tracer) - 6000 rounds.

	<u>Hours</u>
INFANT Boresight Procedures	2.7
Critique	1.0
Graduation	<u>0.5</u>
Total	29.7

4. Flight Instruction

a. Day:

Transition in UH-1M	3.0
Left Seat Tracking	1.5
Right Seat Tracking	1.5
Gunnery Left Seat	1.5
Gunnery Right Seat	<u>3.0</u>
Total	10.5

b. Night:

Left Seat Tracking	1.5
Right Seat Tracking	3.0
Left Seat Miniguns	1.5
Right Seat Rockets	6.0
Tactics	<u>3.0</u>
Total	15.0

APPENDIX I

INFANT NEW EQUIPMENT TRAINING TEAM PROGRAM OF INSTRUCTION

MAINTENANCE PERSONNEL

1. Purpose: To qualify MOS 26D, 26T, or 35E trained personnel to perform organizational and direct support maintenance on the Image Intensifier System, Night Vision, AN/ASQ-132.

2. Scope: The course provides a total of 193 hours of instruction broken out as follows:

a. Classroom (Conference) instruction - 121 hours

b. Practical exercise - 72 hours.

3. Objectives:

a. To provide the student with a working knowledge of the AN/ASQ-132.

b. To provide the student with a working knowledge of troubleshooting procedures for the AN/ASQ-132.

c. To provide the student with a working knowledge of direct support special test equipment for use with the AN/ASQ-132.

d. To provide the student with familiarization of the special test equipment used in general support maintenance of the AN/ASQ-132.

4. <u>Classroom and Practical Exercise Instruction</u>	<u>Hours</u>
a. <u>Introduction</u> :	
Film, slides, mock-up, and organizational maintenance	8
b. <u>Power Distribution Functional and Circuit Analysis</u> :	
Power requirements	1
DC interface	1
AC interface	1
Overvoltage absorber	1
Low voltage power supply	2
High voltage power supply	<u>2</u>
Total	8

	<u>Hours</u>
c. DS Maintenance of LVPS and HVPS (Laboratory)	4
d. <u>Remote View (RV) Subsystem Functional and Circuit Analysis:</u>	
RV optics	1
RV camera	2
RV camera lead	1
RV camera head	2
RV video channel video	4
RV video channel synchronization	3
RV video channel vidicon power	3
RV video channel symbols	1
RV video channel monitors	3
RV control circuit	4
RV servos	<u>4</u>
Total	28
e. <u>Remote View (RV) Subsystem Laboratory Exercise (PE):</u>	
DS maintenance RV camera voltage	3
DS maintenance RV video and synchronization	7
DS maintenance RV secondary power	1
DS/GS maintenance RV video chain	3
DS/GS maintenance RV symbols	1
DS/GS maintenance monitors	3
DS/GS maintenance RV control circuits	3
DS maintenance RV optics	1
DS maintenance RV system alignment	<u>4</u>
Total	26

	<u>Hours</u>
f. <u>Direct View (DV) Subsystem Functional and Circuit Analysis:</u>	
DV optics	1
DV control circuits	7
DV servos	12
DV image motion compensation	<u>2</u>
Total	22
g. <u>Direct View (DV) Subsystem Laboratory Exercise:</u>	
DS control circuits	6
GS control circuits	1
DS maintenance servos	9
GS maintenance servos	2
DS maintenance removal and installation of elevation gear assembly	1
DS maintenance elevation gear assembly alignment	1
DS maintenance DV camera replacement	8
DS maintenance DV system alignment	6
DS maintenance DV resolution readings	1
DS maintenance DV half turret removal and installation	<u>3</u>
Total	38
h. <u>Searchlight (SL) Subsystem Functional and Circuit Analysis:</u>	4
i. <u>Searchlight (SL) Subsystem Laboratory Exercise:</u>	
SL alignment	1
SL DS maintenance and lamp replacement	2
SL junction box maintenance	<u>1</u>
Total	4

	<u>Hours</u>
j. <u>Overall System Preventive Maintenance:</u>	
Removal and installation of AN/ASQ-132	4
Preflight	3
Dessicant change and purging	<u>1</u>
Total	8
k. <u>Records and Test Equipment:</u>	
Records 2404, 2407, 2408 series, 2409 daily and weekly status reports:	3
Test equipment - Power supplies, oscilloscopes, digital readout and voltmeter, multimeter, pulse generator, test oscillator, electrostatic voltmeter, viewer test kit, and flight line test kit:	<u>9</u>
Total	12
l. <u>Lessons Learned (Maintenance) and Review of Spares:</u>	3
m. <u>Boresight:</u>	5
n. <u>Exams and Quiz:</u>	6
o. <u>Commander's Time:</u>	16
p. <u>Graduation:</u>	<u>1</u>
Grand Total	193

4. Summary

	<u>Classroom</u>	<u>Laboratory</u>
Introduction	8	
Power distribution-analysis	8	4
RV analysis	28	26
DV analysis	22	38
SL analysis	4	4

	<u>Classroom</u>	<u>Laboratory</u>
Overall PM	8	
Records and test equipment	12	
Lessons learned	3	
Boresight	5	
Tests	6	
Commander's time	16	
Graduation	<u>1</u>	
Total	121	<u>72</u>

APPENDIX J

HUMAN FACTORS QUESTIONNAIRE SUMMARY

1. EVALUATOR PROFILE

a. Rank:

LTC	1
MAJ	1
CPT	4
1LT	3
CW2	2
WO1	5

b. MOS:

1981	8
4823	1
100 B	4
100 E	3

c. Age: The average age was 26 years, with the oldest being 39 years and the youngest being 21 years.

d. Weight: The average weight was 171 pounds, with the heaviest being 200 pounds and the lightest being 120 pounds.

e. Height: The average height was 70.8 inches, with the tallest being 75 inches and the shortest being 65 inches.

f. Experience at the Start of the Evaluation:

(1) The average total pilot experience of each aviator was 1,400 hours. The aviator with the most experience had 4,310 hours; the one with the least had 389 hours.

(2) The average helicopter experience of each aviator was 1,140 hours. The pilot with the most experience had 2,450 hours; the one with the least had 249 hours.

(3) The average combat helicopter experience was 645 hours. The aviator with the most had 1,293 hours; the one with the least, 15 hours.

(4) The average pilot experience with the UH-1C was 106 hours. The pilot with the most experience had 700 hours; the one with the least, zero hours.

g. Experience at the End of the Evaluation:

(1) The average aviator experience as pilot with the AN/ASQ-132 was 25.5 hours. The pilot with the most experience had 94.5 hours; and the pilot with the least had zero hours.

(2) The average aviator experience as copilot/gunner with the AN/ASQ-132 was 21.6 hours. The aviator with the most experience had 73 hours; and the one with the least, zero hours.

2. EVALUATORS' OBSERVATIONS

The following is a summary of operator response to the human factors questionnaire. Respondents were asked to reply only to those questions concerning subjects with which they had personal experience. The questions are given below. A series of possible responses is listed beneath each question. The first number, without parentheses, represents the number of times evaluators chose a given response. The second number, in parentheses, represents the corresponding percentage out of all persons responding to the question.

(1) List the most common missions flown during the evaluation. (Use 1, 2, 3 to indicate the most frequent missions.)

(a) First Choice

<u>1</u> Surveillance	76	(91%)
<u>2</u> Armed Reconnaissance	4	(4.5%)
<u>3</u> Fire Support	4	(4.5%).

(b) Second Choice

<u>1</u> Fire Support	10	(40%)
<u>2</u> Training	10	(40%)
<u>3</u> Surveillance	5	(20%).

(c) Third Choice

<u>1</u> Training	7	(70%)
<u>2</u> Fire Support	3	(30%).

(2) List the most common sorties flown during the evaluation. (Use 1, 2, 3 to indicate the three most frequent sorties.)

(a) First Choice

<u>1</u>	Armed Reconnaissance	70	(83%)
<u>2</u>	Surveillance	9	(11%)
<u>3</u>	Armed Escort	4	(5%)
<u>4</u>	Search and Rescue	1	(1%).

(b) Second Choice

<u>1</u>	Surveillance	51	(73%)
<u>2</u>	Armed Reconnaissance	9	(13%)
<u>3</u>	Training	3	(4.5%)
<u>4</u>	Search and Rescue	3	(4.5%)
<u>5</u>	Combat Assault	2	(2.5%)
<u>6</u>	Armed Escort	2	(2.5%).

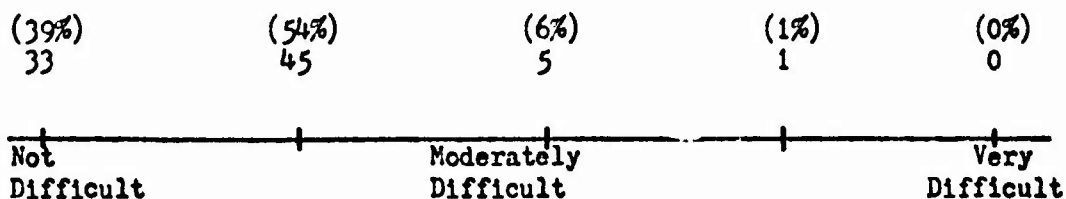
(c) Third Choice

<u>1</u>	Training	15	(59%)
<u>2</u>	Combat Assault	11	(41%).

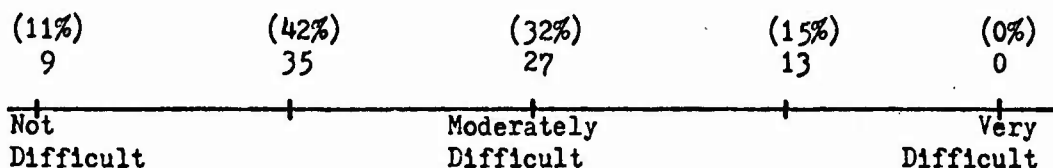
(3) In the aviator's opinion, the most useful missions were in connection with or in support of:

(a)	Armed Reconnaissance	67	(81%)
(b)	Surveillance	12	(13%)
(c)	Infiltration	3	(4%)
(d)	Riverline	2	(2%).

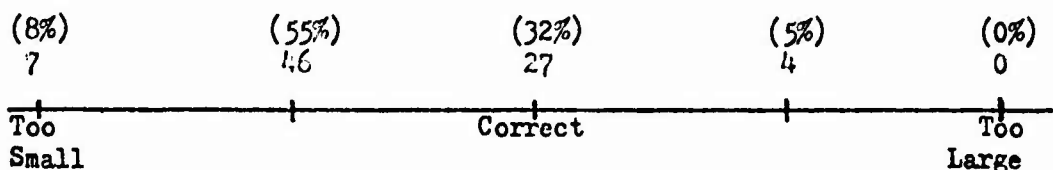
(4) Was the AN/ASQ-132 excessively difficult to check out prior to mission?



(5) Was it excessively difficult to operate the system under tactical conditions?



(6) Was the field of view adequate in size for speed and movement of the helicopter?



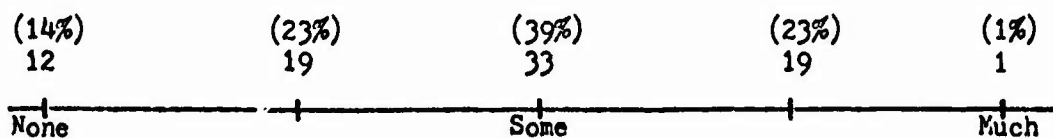
(7) Did relocation of aircraft instruments or controls cause any difficulty in operation of the aircraft?

- (a) Yes 24 (28%)
 (b) No 60 (72%).

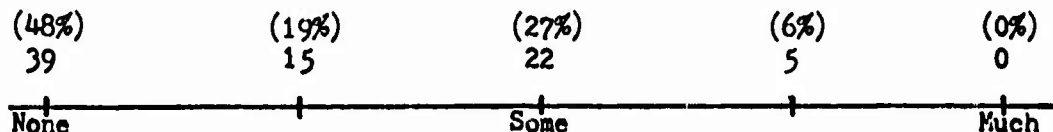
(8) If relocation caused difficulty, which function was impaired?

- (a) Instruments 5 (21%)
 (b) Controls 19 (79%).

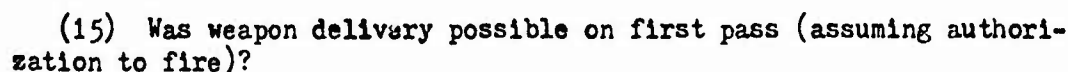
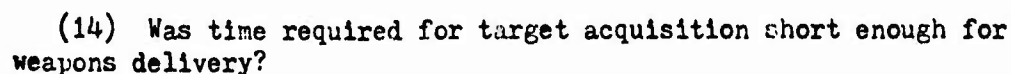
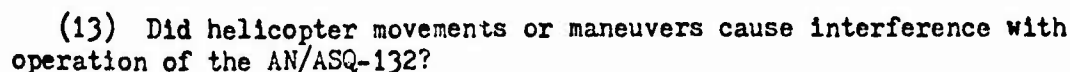
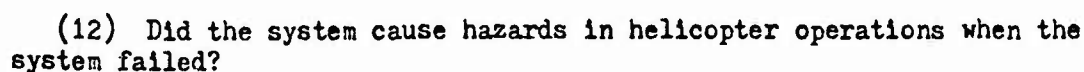
(9) Did presence of the AN/ASQ-132 cause other interference or inconvenience in helicopter operation?



(10) Did the system cause hazards in noncombat helicopter operation?



(11) Did the system cause hazards in helicopter combat or emergency operation?



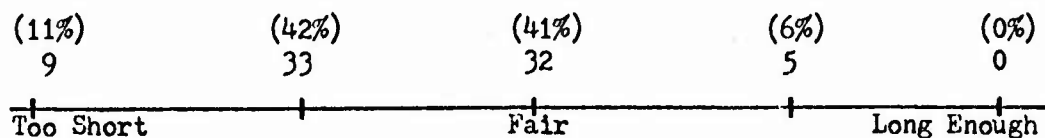
NO 39 (56%).

No 9 (23%).

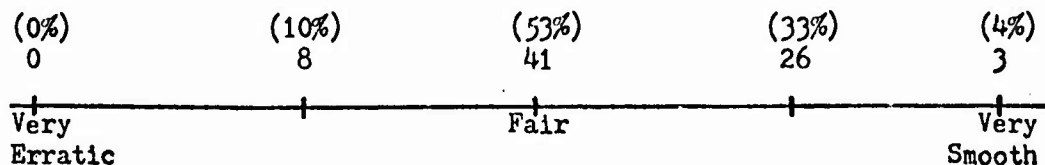
No 15 (23%).

No 27 (60%).

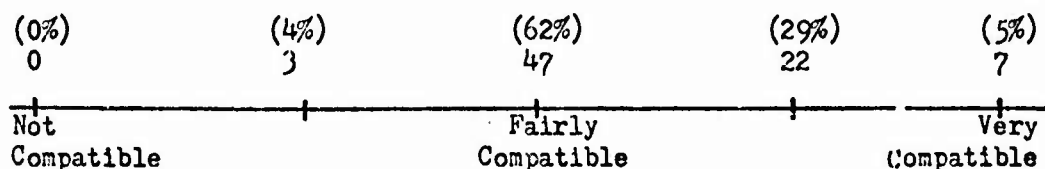
(17) Was target acquisition range adequate for range of weapon system?



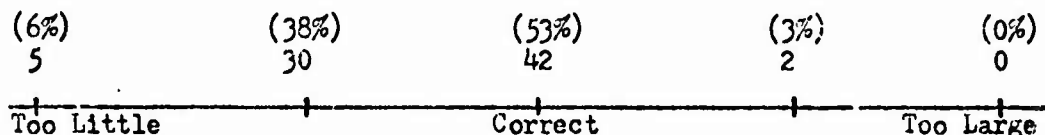
(18) Was tracking movement relatively smooth and continuous?



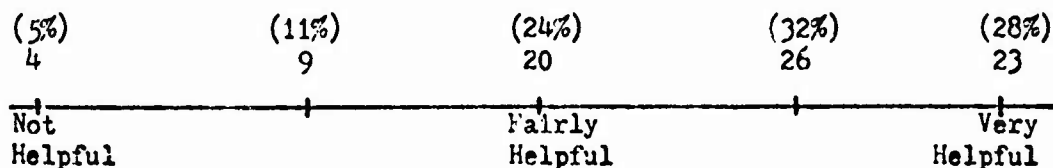
(19) Was the tracking movement compatible with helicopter and/or M21 system movement?



(20) Was magnification sufficient or excessive for effective operation?



(21) Was the independent capability for pilot and copilot/gunner to be looking in different directions a significant aid to operators?



(22) Direct View and Remote View sensors were used primarily for:

	<u>PV only</u>	<u>DV only</u>	<u>Both</u>
(a) Search	4 (5%)	5 (6%)	70 (89%)
(b) Navigation	59 (80%)	3 (4%)	12 (16%)

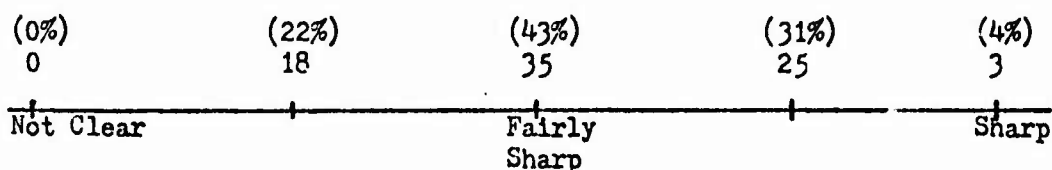
	<u>RV only</u>	<u>DV only</u>	<u>Both</u>
(c) Rocket firing	79 (100%)	-----	-----
(d) Minigun firing	-----	79 (100%)	-----
(e) Target acquisition	4 (5%)	12 (16%)	60 (79%)
(f) Tracking	10 (22%)	3 (6%)	33 (72%)
(g) Terrain following	39 (58%)	3 (5%)	25 (37%)

(23) Were the RV displays used with or without the filter?

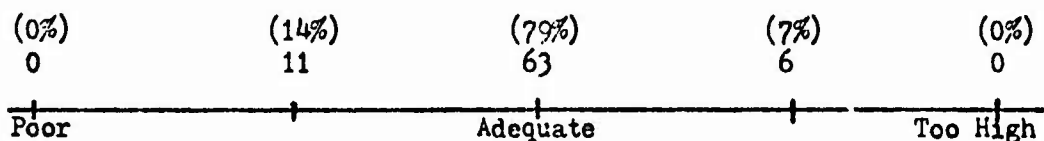
(a) With 77 (93%)

(b) Without 6 (7%).

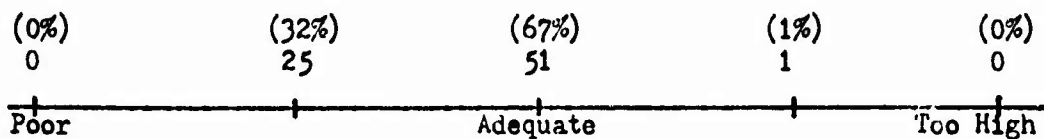
(24) Was the RV image detailed and sharp?



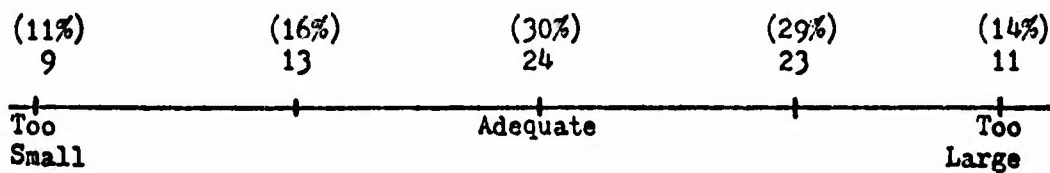
(25) After adjusting, the RV image brightness was:



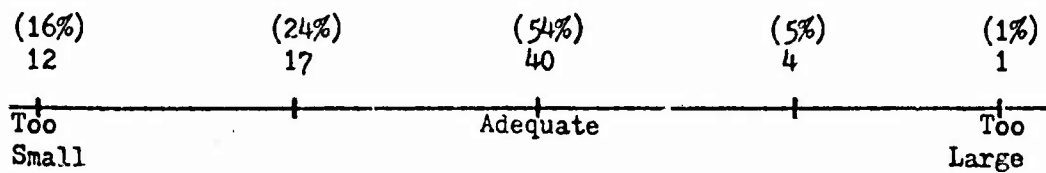
(26) After adjusting, the RV image contrast was:



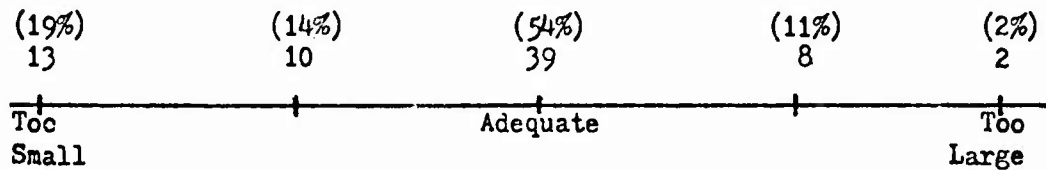
(27) For target identification, the largest RV field of view was:



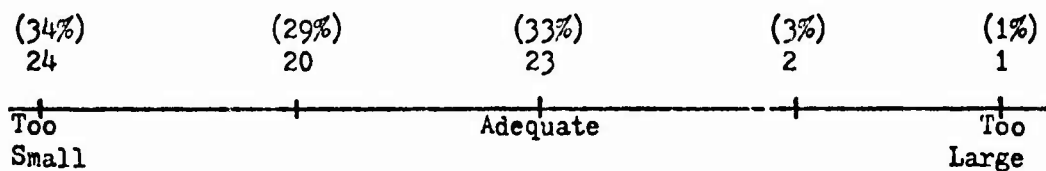
(28) For target identification, the smallest RV field of view was:



(29) For target tracking, the largest RV field of view was:



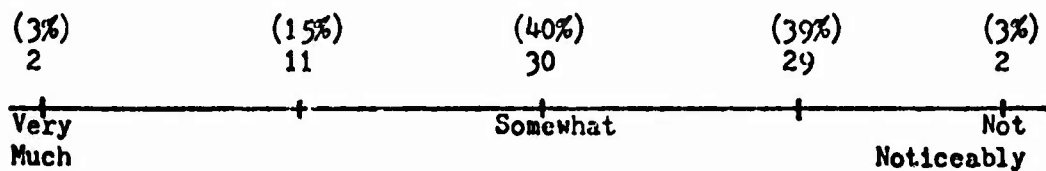
(30) For target tracking, the smallest RV field of view was:



(31) Did use of the RV subsystem distort distance and/or size estimate?

(a) Much distortion (very often)	11	(14%)
(b) Often	17	(23%)
(c) Somewhat (occasionally)	36	(47%)
(d) Seldom	1	(1%)
(e) Not at all	0	(0%)
(f) Do not know	2	(15%).

(32) Did use of RV subsystems with filter interfere with dark adaptation?



(33) Was there annoying or disabling glare associated with the RV?
(As many answers as appropriate were checked.)

(a) None	6	(4%)
(b) Direct	53	(39%)
(c) Reflected	38	(28%)
(d) In daylight	3	(2%)
(e) During weapons delivery	27	(20%)
(f) Other	9	(7%).

(34) How would you classify this glare?

(a) Annoying	51	(66%)
(b) Temporarily disabling	26	(34%).

(35) Did use of the RV system result in headaches or other symptoms
(e.g., eye discomfort, muscle fatigue)?

(a) Headache	4	(5%)
(b) Other	12	(13%)
(c) No replies	71	(82%).

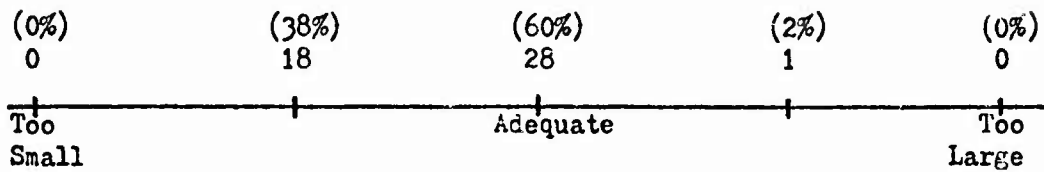
(36) How sharp was the DV image?

(4%) 2	(19%) 9	(40%) 19	(37%) 18	(0%) 0
Poor		Fair		Fine

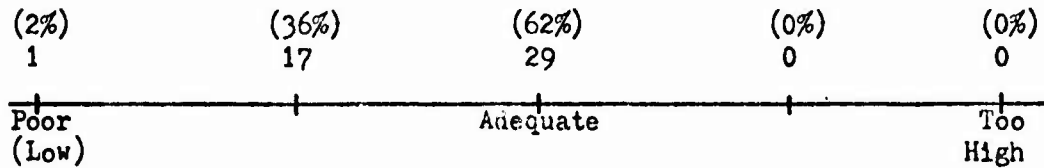
(37) After adjustment, how was the DV image brightness?

(0%) 0	(33%) 15	(67%) 31	(0%) 0	(0%) 0
Poor (Too Low)		Adequate		Too High

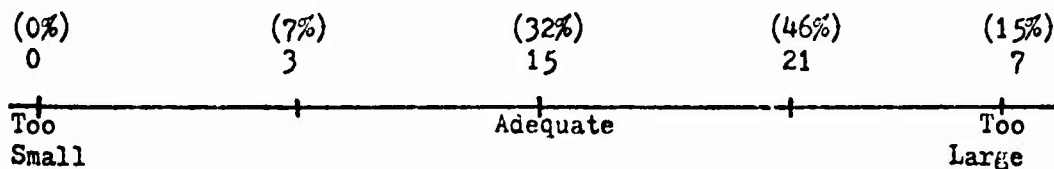
(38) After zooming, the DV image size was:



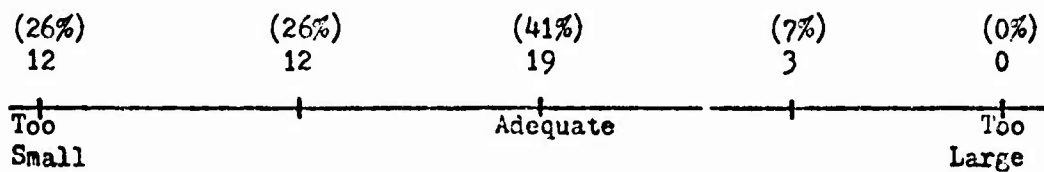
(39) After adjustment, the DV image contrast was:



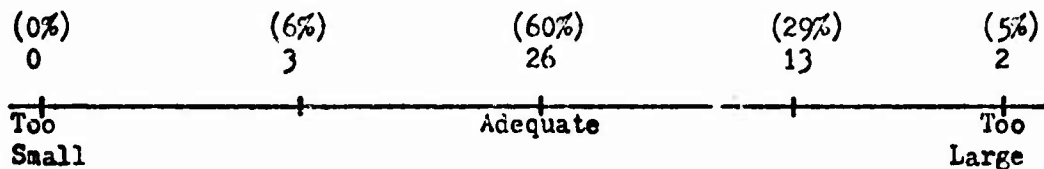
(40) For target identification, the largest field of view in the DV subsystem was:



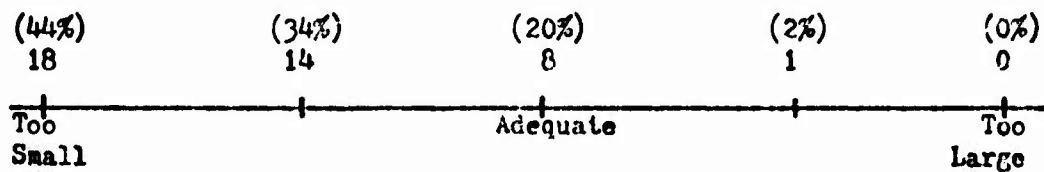
(41) For target identification, the smallest DV field of view was:



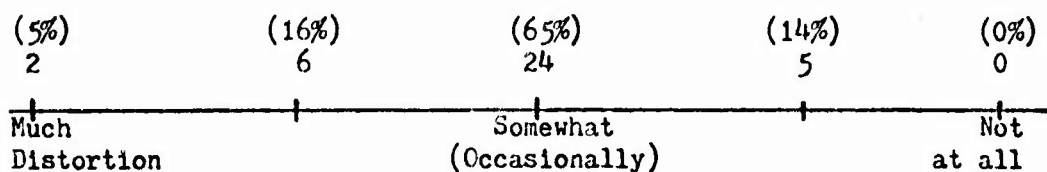
(42) For target tracking, the largest DV field of view was:



(43) For target tracking, the smallest DV field of view was:



(44) Did use of DV subsystem distort distance and/or size estimates?



(45) Did use of DV subsystem interfere with dark adaptation, reducing sensitivity of unaided night vision?

- (a) Yes 37 (79%)
- (b) No 10 (21%).

(46) Was the non-viewing eye able to retain night vision?

- (a) Yes 35 (83%)
- (b) No 7 (17%).

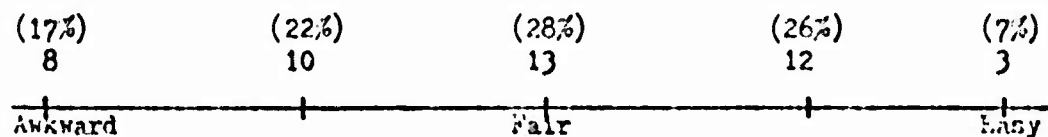
(47) Was there annoying or disabling glare (each applicable entry was checked)?

- (a) None 16 (24%)
- (b) Direct 22 (33%)
- (c) Reflected 6 (9%)
- (d) During weapons delivery 20 (31%)
- (e) Other 2 (3%).

(48) Glare reported above was:

- (a) Annoying 11 (35%)
- (b) Temporarily disabling 20 (65%).

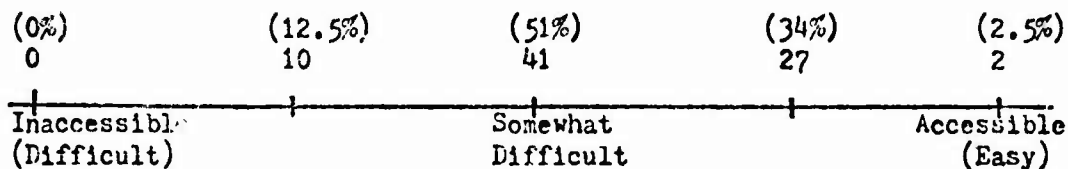
(49) Were optics easy to reach?



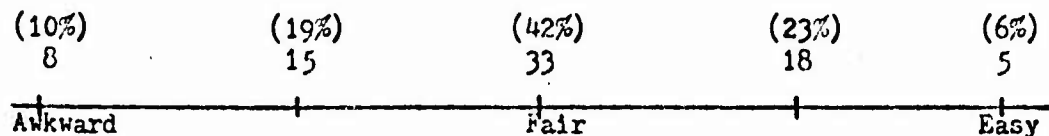
(50) Did use of DV subsystem result in headaches or other symptoms (e.g., eye discomfort, muscle fatigue)?

- (a) Headaches 5 (6.5%)
- (b) Other 18 (23.5%)
- (c) Did not comment 54 (70%).

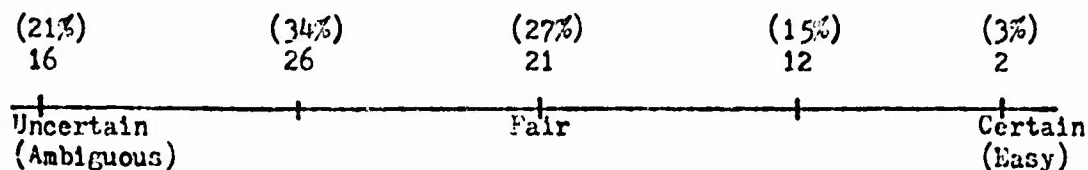
(51) Were controls easy to reach?



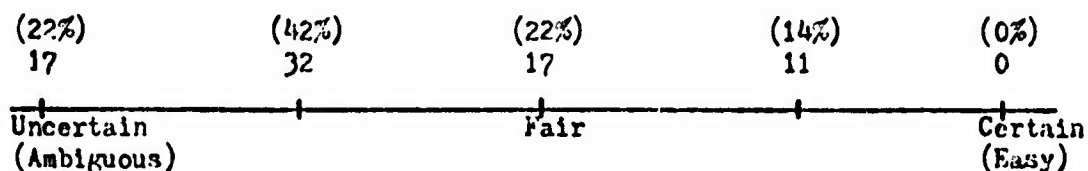
(52) Were controls easy to move, handle?



(53) Under tactical or low light level conditions were controls reliably identified by touch alone?



(54) Were you able to operate and identify functional controls, positions (or modes) on the controls by touch alone?



(55) Were certain controls ever inadvertently operated?

- (a) Yes 20 (26%)
- (b) No 58 (74%).

(56) Which control-display feature(s) most enhanced information (detection, identification, tracking) or was (were) most useful?

(a) Image stabilization	42	(36%)
(b) Variable magnification	40	(34%)
(c) Target illumination	25	(21%)
(d) Variable display brightness	7	(6%)
(e) Electronic focus (variable)	3	(3%)
(f) Other	0	(0%).

(57) Which control-display feature did you not use?

(a) Electronic focus	26	(30%)
(b) Searchlight	11	(13%)
(c) Other	2	(2%)
(d) Used all	48	(55%).

(58) Indicate your overall opinion of consideration given to the man in the man-machine system.

(6%)	(21%)	(43%)	(14%)	(16%)	(0%)
5	18	36	12	13	0
Poor		Fair		Good	Excellent

APPENDIX K

NIGHT PHANTOM (INFANT)

SECTION I

CONCEPT OF OPERATIONS

1. This operation initially utilized OV-1 aircraft equipped with Infrared (IR) or Side Looking Airborne Radar (SLAR) sensors to detect the target, and a TPN/18 approach control radar to direct AH-1G gunships to it. The gunships then struck the target, which was illuminated by a UH-1H flare-ship. The concept was first developed and evaluated by the 307th Combat Aviation Battalion, 164th Combat Aviation Group. This unit operated in Kien Giang Province near the Cambodian Border. Its purpose was to impede night infiltration from Cambodia across the Ving Te Canal into the 44th Special Tactical Zone. The apparent success of the initial Night Phantom effort led to a decision that the operation should be expanded to include the U Minh Forest. Thereafter, for identification purposes, the Kien Giang operation was titled Night Phantom (North), and the U Minh operation was Night Phantom (South). The SLAR sensors were more effective in the Kien Giang area, while IR sensors proved more effective in the U Minh Forest.

2. The basic Night Phantom concept utilizes one OV-1B or C (SLAR or IR) aircraft, one UH-1H C&C ship configured to drop flares, and two AH-1G attack helicopters as its air assets. For ground control, the 307th Aviation Battalion uses a TPN/18 radar supplied by the Air Traffic Control Company. In addition, a data terminal station AN/TAQ-1 for the SLAR and IR readouts, is established next to the radar van. The INFANT was substituted in the operation for the AH-1G (see Figure K-1) in an attempt to add the element of surprise (no flares prior to strike).

3. The U Minh Forest has long been known as an area occupied and controlled by the VC. It has been known and confirmed by multiple intelligence sources that there is frequent movement in the area at night but, because of the nature of the terrain and enemy strength, these targets have been inaccessible to ground troops. To attack these targets at night proved extremely difficult because of the very poor navigational aspects of the terrain, plus the fact that the enemy was frequently concealed by overhead foliage. The problem remained a very basic one of any military operation: finding, fixing, and destroying the enemy.

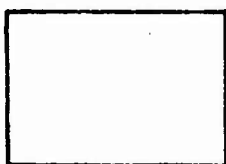
4. To find the enemy, using the Night Phantom (INFANT) concept (see Figure K-2), an OV-1 Mohawk with IR or SLAR equipment flew in a pre-determined pattern over the area of interest; he was tracked by the radar. Target surveillance was monitored in the aircraft as well as at the data terminal station next to the radar van. The readout in the data terminal station is near real-time, and the accuracy is considered to be within 30 meters. Target coordinates were plotted in the radar van. The fire team would be scrambled based upon the number of targets and the size of a particular sighting.

FIND

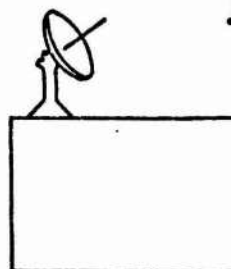


OV-1 MOHAWK
INFRARED OR SLAR

FIX

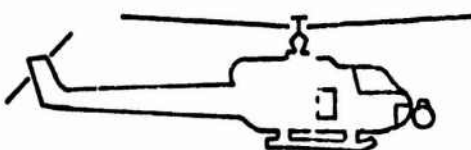
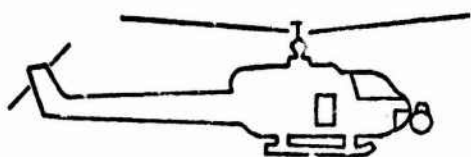


DATA
TERMINAL STATION FOR
INFRARED OR SLAR
AN/TAQ1 OR AN/TKQ2

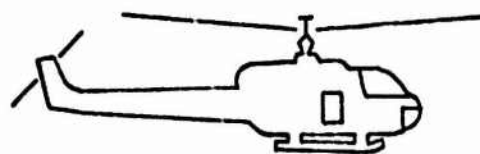


#1
TPN / 18
RADAR STATION

DESTROY



ARMAMENT
4,500 RDS MINIGUN
14 ROCKETS



FLARES
20-XM24 FLARES

FIGURE K-1. Assets for Night Phantom (INFANT)

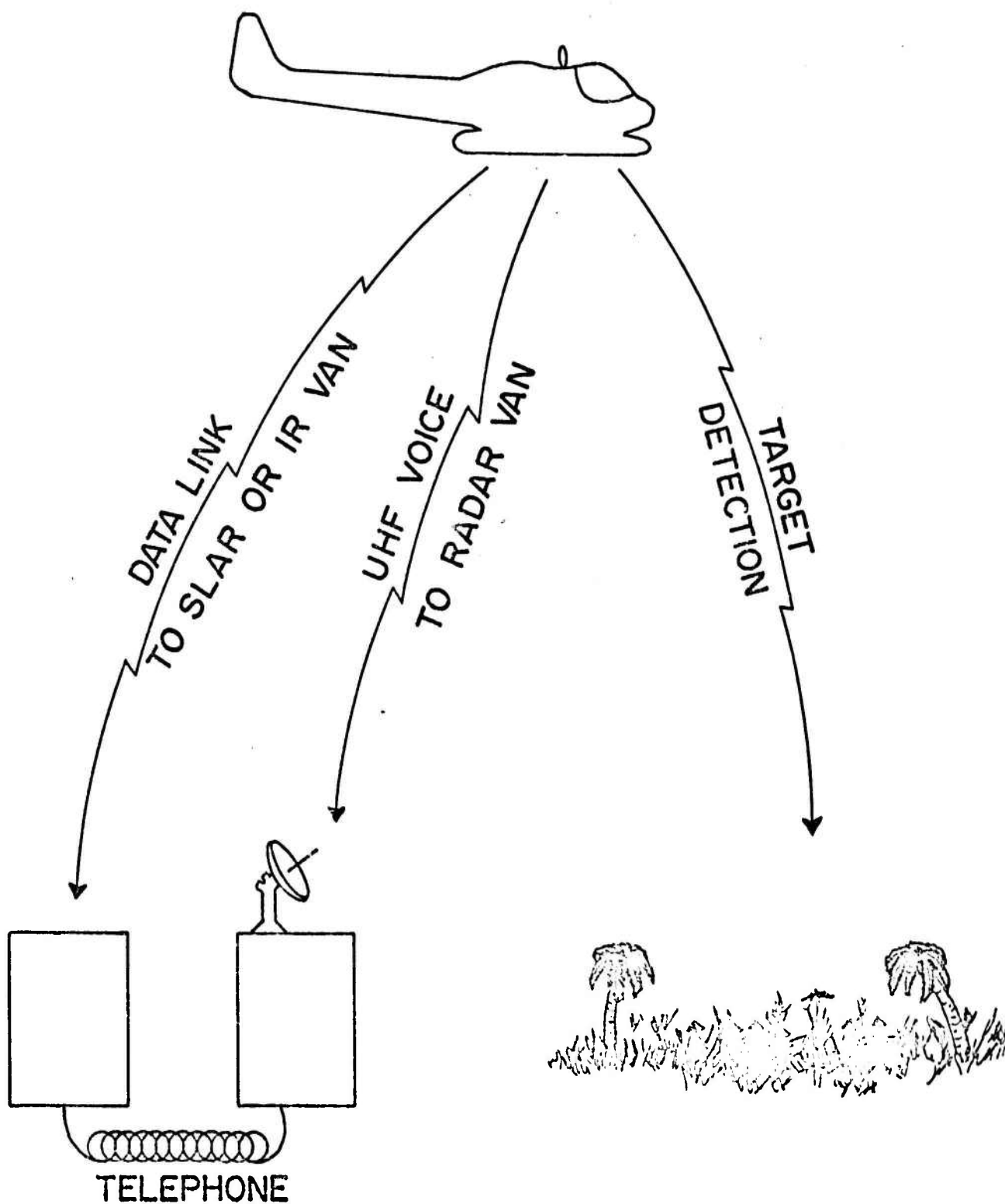


FIGURE K-2. Target Acquisition in Night Phantom Operation

5. In order to coordinate the attack, an officer from the armed helicopter company was assigned to the radar van and designated as the Target Selection Officer (see Figure K-3). This officer was responsible for obtaining the clearance to fire. This was initially a problem in the U Minh Forest area, because clearance was necessary from sector as well as from the ARVN division conducting operations on the fringe of the area. The target selection officer had landline communication with the sector duty officer, who had communication with the ARVN division. The locations of all friendly forces were plotted prior to the arrival of Night Phantom assets. Even with double clearance required, clearance time was reduced to an average of 5 to 10 minutes from 1 to 1 and $\frac{1}{2}$ hours during the first few nights of the operation. This allowed time for the aircraft to scramble, and was not considered excessive. When an ARVN division is not operating in the area involved, it is anticipated that clearance can be obtained immediately.

6. With the fire team airborne and clearance received, the fire team was vectored to the target. For the target selection officer, this maneuver was very similar to the actions taken by a forward air controller. It was necessary for him to consider enemy and friendly locations, and he in fact gave the order for the INFANTS to fire. Final visual adjustment on target was made onboard INFANT by viewing the target through either the direct view eyepiece or remote view TV-monitors. The INFANTS were armed with flechette rockets. This rocket is an area type weapon and has proven to be excellent in jungle terrain. Because of its area coverage, it is not fired within 5 km of friendly troops.

7. To facilitate this operation, aerial photos were made during daylight hours and all other available intelligence sources tapped to establish preplanned targets. Coordinates of suspected targets were given to the target selection officer each night, and fired upon if no sightings were made by the OV-1 aircraft. This enhanced the productiveness of the air assets, even when the SLAR/IR aircraft was unable to locate targets.

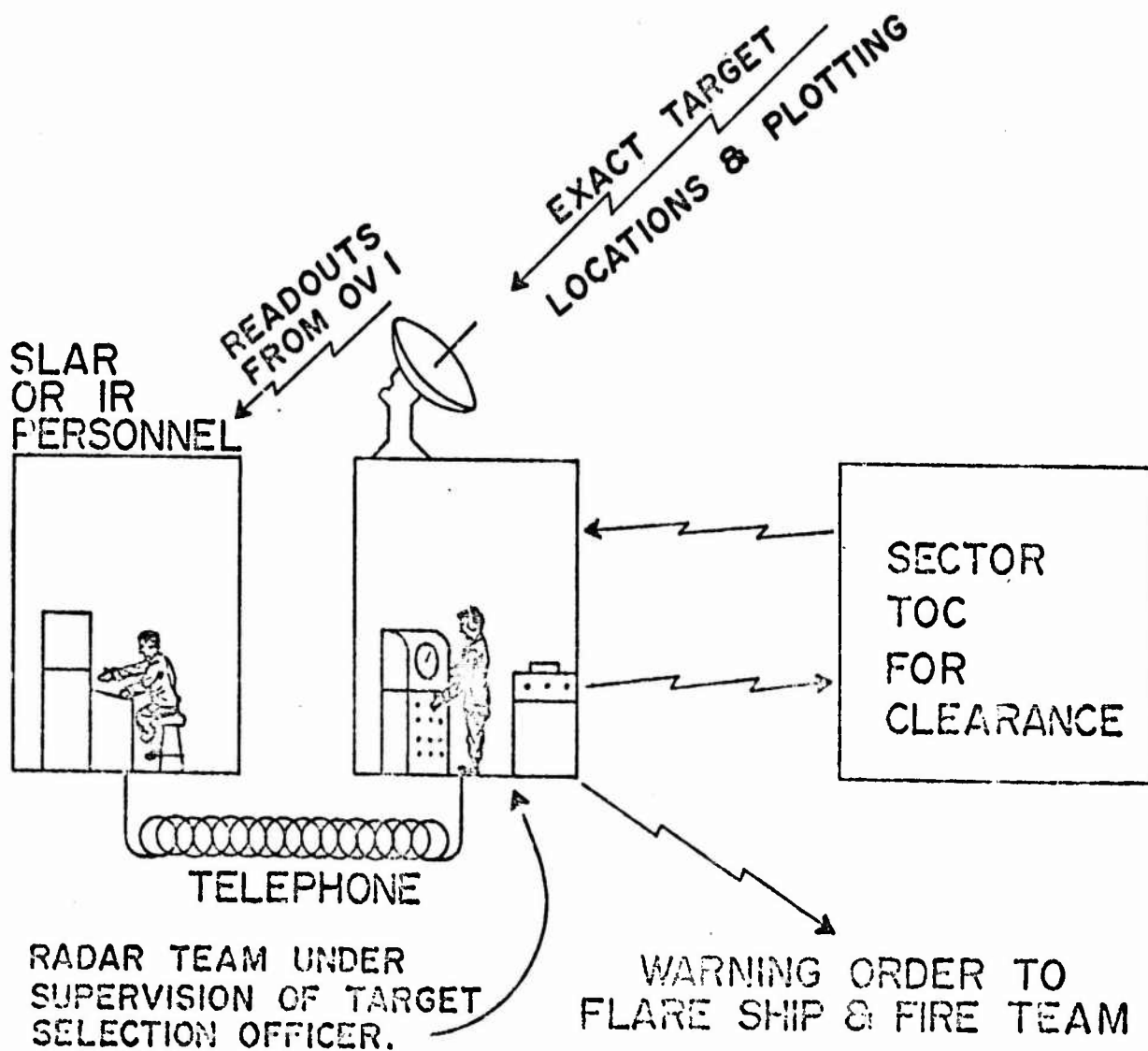


FIGURE K-3. Night Flare Control Procedures

SECTION II

NIGHT PHANTOM OPERATIONS WITH INFANT TEAM, 1-10 JAN 70

The INFANT NET Team arrived at Can Tho 31 December 1969. The period of operation was from 1-10 January and the missions were conducted mainly under minimum ambient light (starlight) conditions.

1. MISSION SUMMARIES

a. 1 January 1970. The initial operation was on the night of 1 January 1970. One INFANT was sent to Ca Mau with one AH-1G and one UH-1H from the 235th AHC. This fire team departed Can Tho at 2100 hours. The mission had been discussed at length prior to take-off, and it had been decided that the INFANT would fly fire team lead at an altitude of 600-800 feet. It would use the INFANT equipment to locate any enemy target picked up by the OV-1 aircraft. The AH-1G would be in trail formation behind the INFANT and at 1000 feet AGL. The UH-1H would operate at 2500 feet AGL, its primary mission was crew pick-up if one of the two gunships went down. The UH-1H also had flares on board for illumination if needed. During this first mission, when a target was located by the INFANT aircraft, it immediately placed fire on it, marking it for the AH-1G. Due to the low altitude at which the INFANT aircraft operated, it was sometimes impossible to mark the target with rockets on the first pass. In such a situation, INFANT could climb to 1000 feet, and then mark the target with rockets, enabling the AH-1G to locate the target and engage it. The UH-1H, orbiting the area at its altitude of 2500 feet, was able to keep the two gunships advised of any enemy fire they were receiving. This tactic proved to be very effective and was utilized in later missions. At this time, the radar station at Ca Mau was down for maintenance, and the fire team found it very difficult to navigate in the AO. Only two targets were located. Clearance was obtained from sector and the targets were engaged. The strikes, which were put in at WR 0298 and VR 8322, resulted in 7 sampans destroyed, 3 structures damaged, and 4 KBH. The mission was terminated at 0420, all assets returning to Can Tho. The INFANT crew reported the biggest problem they encountered was the lack of moonlight. It was so dark in the AO that the INFANT aircraft was forced to fly as low as 600 feet AGL in order to pick up features on the ground. Even though the INFANT aircraft was flying blacked out, this placed the aircraft and crew in a very vulnerable position. It was also felt that, if the Ca Mau radar had been operational, it would have increased the efficiency of the mission by aiding in navigation and vectoring the gunships to the target.

b. 2 January 1970. The following night, two INFANT, one AH-1G, and one UH-1H* aircraft departed Can Tho at 2400 hours. The AO was the U Minh Forest, with the aircraft staging out of Ca Mau; the radar at Ca Mau was now operational. The two INFANT aircraft operated as a light

*For rescue operation, if needed.

fire team at approximately 600-1000 feet AGL, and the AH-1G covered them from 1500 feet AGL. Again, the UH-1H orbited the area at 2500 feet AGL to provide illumination or crew rescue, as needed. Four targets were picked up by the OV-1 and passed to Ca Mau radar; clearance was obtained from sector, and the gunships and UH-1H were scrambled to the target coordinates. The first three targets were engaged with no difficulties; however, when the lead INFANT aircraft began his gun run on the fourth target he was seen to fire two rockets, level off, and then crash into the swamp-like terrain. The aircraft exploded and burned on impact. The time was 2320 hours. The crash was fatal to all four crew members aboard the aircraft. No radio transmissions were received from the aircraft during this fatal gun run. The remaining INFANT aircraft, AH-1G, and UH-1H remained over the downed aircraft and assisted in recovery operations until 0515 hours, 3 January, at which time they returned to Can Tho. No other targets were engaged after 2320. The crew of the INFANT aircraft which returned stated that the system was working very well, and that the targets were easy to pick up from 800 to 1000 feet. The crew felt the use of two INFANT aircraft as a fire team had worked out very well; this was the first time that this tactic had been used. The lead aircraft flew at 800 feet to locate the target and mark it. The second INFANT aircraft was flying trail formation at 1000 feet and engaged the target with rockets and miniguns. The AH-1G was utilized if more firepower was needed. The Ca Mau radar was very helpful in vectoring the INFANT aircraft to the target, and the INFANT crew stated the radar was essential to the success of the mission. Navigation is extremely difficult while using the INFANT system, especially in the U Minh Forest area where well defined terrain features are almost non-existent.

c. 3 January 1970. The INFANT aircraft did not fly a mission on 3 January because the crew was extremely tired from the previous night's mission; furthermore, crewmembers were required to be present for investigative procedures.

d. 4 January 1970. On 4 January, it was decided that only one INFANT aircraft would be utilized on the mission scheduled for that night, because the other aircraft were not mission-ready. The one INFANT scheduled was to work with the 13th Avn Bn (Cbt) in an AO south and west of its base at Soc Trang. At 2000 hours, the aircraft departed Can Tho for Soc Trang. The assets to be utilized were the one INFANT aircraft, plus "Tiger Surprise"* from the 13th Avn Bn. The INFANT crew reported the system did not work very well on this mission because of an excess of light from burning structures in the area being worked. Tiger Surprise was operating at low altitude, and the fires started by its tracer ammunition made a glare on the INFANT TV screen. The RV system was turned off and only the DV was utilized, since it was apparently less sensitive to the light from the fires. Two strikes were put in by the INFANT aircraft, one at XR 1645 and the other at XR 1741. Only rockets were utilized

*Tiger Surprise is a UH-1H equipped with a mounted .50 caliber machinegun.

on these targets because the INFANT minigun system would not fire. Results from the strikes were not obtained.

e. 5 January 1970. The INFANT team was scheduled for Soc Trang again on 5 January. This time, two INFANT aircraft were utilized with Tiger Surprise. The INFANT fire team departed Can Tho at 1900 hours. Once again, the AO was south and west of Soc Trang. A total of five targets were engaged, resulting in 15 structures and 21 sampans destroyed, and 4 KBH. The INFANT team reported the system worked very well; the targets were clearly visible and a good post-strike recon was conducted. The INFANT crew reported numerous targets in the AO.

f. 6 January 1970. The mission for this night was to again work the Ca Mau area. Two INFANT aircraft, one AH-1G, and one UH-1H were sent to Ca Mau at 2145 hours. A strike was placed on a suspected enemy position at center of mass WR 057049. An agent report credited the strike with killing 30 VC. The INFANT crew reported their system worked very well and, after the moon came up, the ground was clearly definable. The INFANT was used for a poststrike recon of the strike area. Structures and sampans were easy to see; however, no personnel could be observed. No other strikes were put in because the Ca Mau radar became nonoperational at 2330 hours. The aircraft returned to Can Tho at 0420 hours.

g. 7 January 1970. On this date, two INFANT aircraft, one AH-1G, plus a UH-1H flaership were sent to Chi Lang to support TF Blackhawk. Initially, the aircraft were to be utilized for search-and-destroy missions along the Cambodian Border. During the mission, the aircraft were sent to support an outpost under heavy attack. The outpost, which was located at WT 102080, was extremely close to the border. During the firefight, the INFANT fire team accidentally crossed the border into Cambodia. The UH-1H, which served as the C&C ship, quickly realized the INFANT fire team was across the border and directed it back into Vietnamese airspace. The C&C aircraft then escorted the INFANT fire team back to Chi Lang. As the INFANT crews were unfamiliar with the border area at night and radar control was not available, the aircraft returned to Can Tho.

h. 8 January 1970. The INFANT fire team was to return to Chi Lang the following night. While preparing to run up and takeoff, one of the INFANT aircraft, still sitting in its revetment, accidentally fired two rockets. One rocket lodged in the revetment in front of the aircraft, the second rocket traveled almost the entire length of the airstrip and landed in the base ASP. Three large explosions and numerous smaller ones occurred in the ASP from exploding 2.75 inch rockets. The incident was thoroughly investigated by a team of officers from the 307th Avn Bn (Cbt). The investigation revealed no conclusive findings, although a local radar set was considered a possible source of electrical energy sufficient to cause rocket firing.

i. 9 and 10 January 1970. The INFANT aircraft were scheduled to work the Muc Hoa area on those nights. Only one INFANT aircraft was

available to work because the other aircraft was being held by the investigation board. The single INFANT aircraft worked with two UH-1Hs, one of which was equipped with a .50 caliber machinegun and flare pods. The other UH-1H was equipped with a C-123 light cluster (Firefly arrangement) and twin M60's. The INFANT team said this arrangement worked out very well. The INFANT aircraft flew at 800 feet, and the two UH-1H's flew at 1000 and 2000 respectively. Two strikes were put in on the 9th of January, with unknown results. There were negative sightings and negative strikes on the 10th of January. The INFANT team reported their system worked satisfactorily both nights; however, they picked up no targets in the AO; the two strikes on the 9th of January were recon by fire.

On 11 January 1970, the INFANT team departed Can Tho for their home base at Lai Khe.

2. LESSONS LEARNED

In summary, the following lessons were learned from the INFANT team's stay in the Delta: (1) The system was found to be very effective over water, i.e., canals and waterways; (2) The use of radar control is almost essential for the success of the mission, especially in areas where definite terrain features are non-existent; (3) The systems are most effective when utilized in a specified strike zone (SSZ) or a precleared target area; (4) They were less effective against point-type targets than area targets; (5) The system is most effective when the moon is up; (6) Two INFANT aircraft can be utilized as a light fire team with good results (This was tried for the first time on the Ca Mau mission); (7) The INFANT aircraft may also be utilized to conduct post-strike recons.

3. PROBLEM AREAS

Some of the problem areas found were as follows: (1) Without radar control, it is almost impossible for the INFANT aircraft to navigate with any degree of accuracy (For this reason a large AO is needed); (2) On a night that is overcast, or when no moon is up, the INFANT aircraft is required to fly at very low altitudes in order to pick up targets on the ground; (3) When working with AH-1Gs it is hard for the INFANT to mark a target so a Cobra can identify it -- the INFANT's tracer ammunition is invisible to the Cobra, and the target must be marked with rockets; (4) Pilot fatigue is a big problem while flying the INFANT; 4 hours is the maximum desired time on station; (5) Too much light in the AO, from flares or fires, makes the INFANT RV subsystem useless, and it must be turned off to prevent damage to the system.

HVPS - High voltage power supply
IFOV - Instantaneous field of view
IMC - Image motion compensation
INFANT - Iroquois Night Fighter and Night Tracker
IR - Infrared
KBA - Killed by aircraft
KBH - Killed by helicopter
LLTV - Low light level television
LO - Liaison officer
LRU - Line replacable unit
MACV - Military Assistance Command, Vietnam
MSL - Mean sea level
MTBF - Mean-time-between-failures
MTTR - Mean-time-to-repair
NETT - New equipment training team
NORM - Not operationally ready maintenance
NORS - Not operationally ready supply
OPCON - Operational control
OR - Operational ready
PM - Preventive maintenance
RFI - Radio frequency interference
RV - Remote view subsystem of AN/ASQ-132
SEA NITEOPS - Southeast Asia Night Operations (program)
SEC - Secondary emitting cathode
SLAR - Side looking airborne radar
SOI - Signal operating instructions

APPENDIX L
ABBREVIATIONS

AGL - Above ground level

AH-1G - Helicopter, Attack, AH-1G

ALC - Automatic light control

AM - Airmobile

ANTS - Airborne Night Television System

AO - Area of operations

APU - Auxiliary power unit

ASP - Ammunition supply point

BDA - Battle damage assessment

C&C - Command and control (used in reference to an aircraft's primary purpose)

CTZ - Corps Tactical Zone

DAC - Department of the Army Civilian

DV - Direct view subsystem of AN/ASQ-132

EER - Electronics equipment representative (DAC)

EL - Electroluminescent

EMI - Electromagnetic interference

ENSURE - Expedited Non-Standard Urgent Requirement for Equipment

FFAR - Folding Fin Aerial Rocket

FFV - Field Force, Vietnam (similar to Corps)

FM - Frequency Modulated

FOV - Field of view (in general terms)

FSR - Field Service Representative (contractor)

GCA - Ground controlled approach radar

GSE - Ground support equipment

HVPS - High voltage power supply
IPOV - Instantaneous field of view
IMC - Image motion compensation
INFANT - Iroquois Night Fighter and Night Tracker
IR - Infrared
KBA - Killed by aircraft
KBH - Killed by helicopter
LLTV - Low light level television
LO - Liaison officer
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OPCON - Operational control
OR - Operational ready
PM - Preventive maintenance
RFI - Radio frequency interference
RV - Remote view subsystem of AN/ASQ-132
SEA NITEOPS - Southeast Asia Night Operations (program)
SEC - Secondary emitting cathode
SLAR - Side looking airborne radar
SOI - Signal operating instructions

SPM - Shots per minute
SSZ Specified strike zone
STANO - Surveillance, target acquisition and night observation
TAOR - Tactical area of responsibility
TOC - Tactical operations center
VC - Viet Cong (guerilla)
VDC - Volts direct current
UGS - Unattended ground sensor(s)
UHF - Ultra high frequency
UH-1C(A) - Helicopter, Utility, UH-1C equipped as an interim attack helicopter
UH-1H - Helicopter, Utility, UH-1H
UH-1M - Helicopter, Utility, UH-1M
USARV - US Army, Vietnam

APPENDIX M

GLOSSARY

Apparent Magnification - The ratio of the angle subtended by a target as seen through an optical system to that as seen by the unaided eye. When discussing the AN/ASQ-132 RV subsystem it is assumed that the measurements are made at normal observation distances from the monitor.

Coaxial (Military use) - Item mounted in such a way that its directional axis is exactly parallel (corrected for parallax at a desired cross-over point) to that of another item's directional axis and on the same mounting. (paraphrased from AR 310-25).

Co-ax (coaxial cable) - A cable that consists of a tube of electrically conducting material surrounding a central conductor held in place by insulation and that is used to transmit signals of high frequency.

Contrast Ratio - A figure used to measure the ability to distinguish a target from its background. This figure is independent of the properties of an optical system. It is defined as the ratio of the intensity of a target minus the intensity of the background to the intensity of the target plus the intensity of the background.

DUFFEL BAG - Unattended ground sensors as employed by US Forces in RVN.

Field of View (FOV) (degrees x degrees) - The azimuth angle of a scene times the elevation angle of a scene as viewed through an optical instrument. Use of this term, depending on context, may include the mechanical scan properties of the AN/ASQ-132 periscopes.

Instantaneous Field of View (IFOV) (degrees x degrees): when discussing the AN/ASQ-132, the field of view as measured with the appropriate periscope fixed.

Fire Team - Normally two armed helicopters operating as a tactical element to accomplish a mission. This term may sometimes be used for two armed helicopters accompanied by an escort or command and control aircraft in the element. The two armed helicopter element is also referred to as a light fire team while three armed helicopters operating as an element is referred to as a heavy fire team.

Flareship - A utility helicopter equipped with aircraft illumination flares. The flares are usually carried in a bin hung from the edge of the cargo compartment floor outboard of the door opening.

Gunship - A helicopter having primary weapon subsystems installed and utilized to provide direct fire support. Helicopters equipped only with crew-served door guns are not in this classification. Armed Helicopters or "gunships" include AH-1G, UH-1B(A), UH-1C(A), UH-1M, and OH-6A(A). (USARV Reg 95-10).

Minigun - Another name for the M134 Automatic Gun or other small caliber Gatling-type (rotating barrels) gun.

Mission - 1. The dispatching of one or more aircraft to accomplish one particular task. 2. The task, together with the purpose, which clearly indicates the action to be taken and the reason therefor. (AR 310-25).

Night Hawk - The Night Hawk system derives its name from its originating unit in RVN. It consists of a UH-1H helicopter with three major components mounted at one side and operated by two crewmen in the cargo compartment. The three major components consist of an AN/VSS-3 searchlight, an AN/TVS-4 night observation device (NOD), coupled by a common framework on the normal M23 door gunner's pintle, and the M134 7.62mm automatic gun (minigun). The minigun is attached to a pallet located in the forward area of the cargo compartment. The entire system can be mounted on either side of the helicopter, or two systems can be mounted in the same aircraft.

Not Operationally Ready Maintenance (NORM) - The total number of hours during the reporting period an aircraft is not operationally ready maintenance. NORM occurs whenever the current status symbol is Red X, or whenever an item essential to the performance of the aircraft mission is not operational due to maintenance requirements.

Not Operationally Ready Supply (NORS) - This is a condition status of an aircraft which cannot be returned to an OR status nor can further maintenance work be performed until the required item of supply has been made available at the work site for continuance of maintenance. NORS time will start when the supply demand has been made and the repair part which has been requisitioned is not available thus prohibiting further maintenance (work stoppage). NORS time will stop when the requisitioned item has been made available to maintenance, and the productive maintenance work required to return the aircraft to an operational readiness status can be resumed.

Operational Ready (OR) - The total number of hours during the reporting period which the aircraft is capable of safe flight and all equipment necessary for performance of its primary mission is on board and ready to perform its mission. The primary mission is that mission for which the aircraft was designed and assigned to the operational unit. Operational readiness status will be measured against this primary mission and will be the determination of the commander of the possessing unit/agency in support of his required mission. The primary mission must be one of the design missions of the aircraft as contained in FM 101-20, US Army Aviation Planning Manual, classified CONFIDENTIAL.

Sortie - An operational flight by one aircraft. One sortie is one aircraft making one takeoff and one landing (not touch-and-go training landings); the purpose of the landing may include loading or discharging personnel or cargo, rearming, or refueling. Armed helicopters will log a sortie for each trip to a landing zone, and each return trip, regardless of whether they land or not. (NOTE: Last sentence not applicable to INFANT). (USARV REG 95-10).

Specified Strike Zone (SSZ) - An area designated for a specific period of time by GVN/RVNAF in which there are no friendly forces or populace and in which targets may be attacked on the initiative of US/FWMAF/RVNAF commanders. (MACV Dir 525-13).

Station Keeping - Used in referring to the ability of an aircraft to remain in a predetermined spatial orientation to another aircraft as in formation flying.

Target Fixation - A phenomenon that occurs to an individual who intensely concentrates visually on a scene before him. Similar to that which is frequently called "day dreaming".

Tri-ax (triaxial cable) - A cable consisting of two wires independently shielded and insulated in a tube of electrically conducting material, normally used in transmitting high frequency signals.

APPENDIX N

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13. ABSTRACT

During the period 26 Nov 69 - 28 Feb 70, the Army Concept Team in Vietnam evaluated the Iroquois Night Fighter and Night Tracker (INFANT) to determine its combat suitability for stability operations in RVN. The weapons system, which consists of three major subsystems -- the Image Intensifier System, Night Vision (AN/ASQ-132), the UH-1M utility helicopter, and the M21 Armament Subsystem --, was evaluated as a whole. However, emphasis was directed toward the image intensifier system. The general purpose of the evaluation was to assess the military worth of INFANT; specific objectives were to determine the following: system capabilities and limitations, maintainability and reliability, human factors implications, employment methods, impact upon the five functions of land warfare, countermeasures taken against the system, and the effectiveness of US Navy Formation Lights when used on night attack helicopters. (U)

The evaluation concluded that INFANT provided an increased nighttime operational capability in the attack/surveillance helicopter role. It also concluded that the reliability and maintainability of the system were acceptable, but that improvement was needed in quality control of spare components, and that correction of deficiencies found in recurring parts failures should result in an improved MTBF and MTTR for the system. Many human factors shortcomings were identified which could be attributed to poor system engineering practices and failure to consider the man-machine interface and the mission profile of the system. The use of night formation lights on gunships resulted in identification of requirements differing from those of utility helicopters. It was noted that many findings in this evaluation appear to have applicability to similar systems under development. (U)

DD FORM 1473

Replaces DD Form 1473, 1 JAN 64, which is obsolete for Army use.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Night Vision						
Airborne Night Vision Equipment						
Airborne Night Fire Control						
Attack Helicopter, Night						
Surveillance Helicopter, Night						
Low Light Level Television						
Fire Control, Night, Airborne						
Night Observation						
Helicopter Utility, UH-1M						
Direct View Image Intensification						
Image Intensification						
Light Amplification						