

FM 44-1

DEPARTMENT OF THE ARMY FIELD MANUAL

U. S. ARMY AIR DEFENSE EMPLOYMENT



HEADQUARTERS, DEPARTMENT OF THE ARMY

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U.S. ARMY AIR DEFENSE EMPLOYMENT

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PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

1. Purpose and Scope

This manual is a guide for air defense commanders and staffs concerned with the employment, command, and control of Army air defense. PART TWO of the manual contains air defense organization and operations for U.S. Army air defense, CONUS. PART THREE contains organization, planning, operations, and special operations for U.S. Army air defense, theater of operations. The material presented is applicable to both nuclear and nonnuclear warfare. FM 44-1A supplements this manual. It contains classified information pertaining to air defense materiel and employment.

2. Recommended Changes or Comments

Users are encouraged to submit recommended changes or comments to improve this manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U.S. Army Air Defense School, ATTN: AKBAAS-NR, Fort Bliss, Tex.

3. References and Glossary

References listed in appendix I should be consulted for details beyond the scope of this manual. The glossary contains abbreviations and definitions pertaining to air defense.

CHAPTER 2

ARMY AIR DEFENSE MATERIEL

4. General

Active air defense is the principal Army means for air defense of important civil and military establishments in the continental United States (CONUS) and the Army field forces. Air defense materiel includes fire distribution systems, NIKE weapon system, and the HAWK weapon system. Other weapon systems and future missile systems are also mentioned.

5. Fire Distribution Systems

a. To exploit the capabilities of air defense weapon systems, fire distribution systems capable of instantaneously responding to the rapid changes in modern air battles are required. The Army now has three integrated electronic display and communications systems (fire distribution systems) capable of meeting this requirement: the Missile Master (AN/FSG-1) and the AN/GSG-5(V) and AN/GSG-6() (BIRDIE) for CONUS defenses, and the Missile Monitor (AN/MSG-4), a fully mobile system for em-

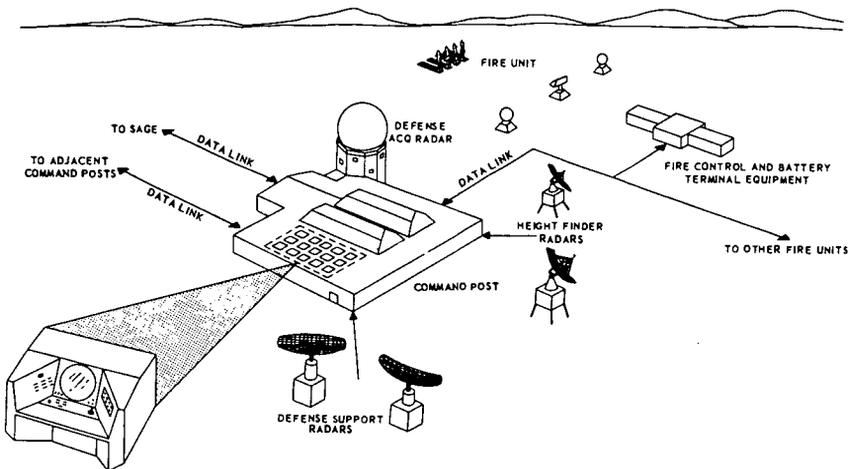


Figure 1. Fire distribution system AN/FSG-1 (Missile Master).

ployment with the field army. The electronic fire distribution systems (FDS) are designed to distribute the fires of Army air defense missile units and to integrate all elements of an Army air defense from target detection to destruction. These systems are designed to collect information on airborne objects, present the information on electronic displays at the Army air defense command post (AADCP), and distribute data to the integrated fire units. At the same time, information on the activities of all fire units of the defense is exchanged. Thus, each fire unit commander receives all reference data available to enable him to effectively select, attack, and destroy hostile airborne objects.

b. The FDS AN/FSG-1 (Missile Master) (fig. 1) consists of an AADCP established at defense level (brigade or group), defense acquisition and height-finder radars, battery terminal equipment, and communications to integrate AD missile batteries into a defense system.

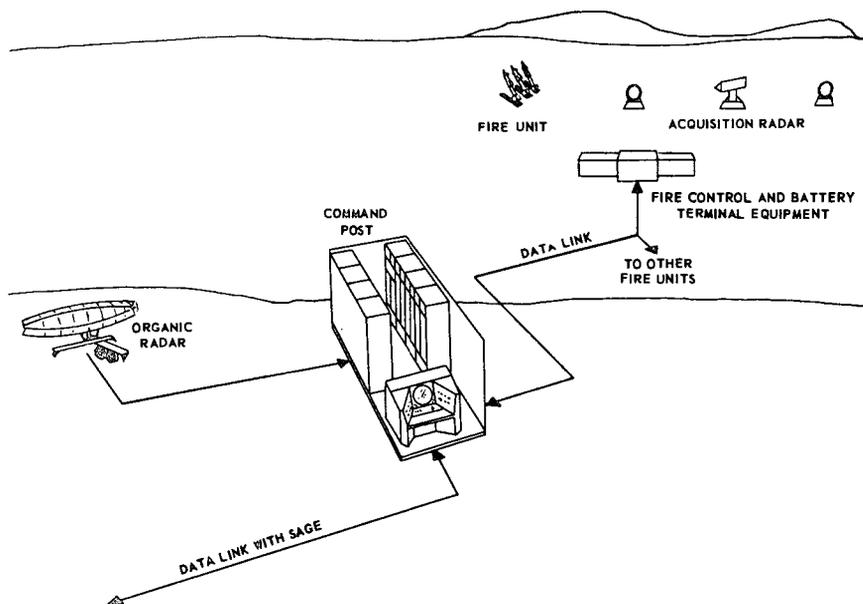


Figure 2. Fire distribution system AN/GSG-5(V) and AN/GSG-6(B) (BIRDIE).

c. The FDS AN/GSG-5(V) (BIRDIE) (fig. 2) consists of an AADCP, defense acquisition radar (organic radar), battery terminal equipment, and communications to integrate up to 16 AD missile batteries into a defense system. The AADCP is established at defense level (group or battalion). There are four different models of the AN/GSG-5(V) system. The particular model used is determined by the requirements of the defense area and is identified by the number of consoles employed. Each console is capable of coordinating up to four missile fire units. Thus an AN/GSG-5(V) system can coordinate up to 16 missile fire units by the use of one to four consoles. The FDS AN/GSG-6() (BIRDIE) consists of an AADCP, defense acquisition radar, battery terminal equipment, and communications to integrate two AD missile batteries into a defense system.

d. The FDS AN/MSG-4 (Missile Monitor) (fig. 3) utilizes standard military vehicles. It is composed of the AADCP AN/MSQ-28 and up to four FDS's AN/MSQ-18.

- (1) The AADCP AN/MSQ-28 is the command post of the AD group commander. The major components of the AADCP AN/MSQ-28 are the frequency scan radar (FSR) AN/MPS-23 (organic radar), radar data processing equipment (RDPE) OA 2308 ()/MSQ-28, and group, fire distribution center (GFDC) OA 2309 ()/MSQ-28.
- (2) The FDS AN/MSQ-18 is that portion of Missile Monitor consisting of a battalion fire distribution center (BFDC) and battery terminal equipment (BTE) for each associated missile battery. The electronic search central AN/GSS-1 provides local radar data at the battalion level.

6. NIKE Weapon Systems

a. *General.* The same basic concepts of operation and command guidance are used for the NIKE-AJAX, NIKE-HERCULES, Improved NIKE-HERCULES, and NIKE-ZEUS weapon systems. To understand how NIKE works, only certain major items of equipment need be considered—a computer and three radars (fig. 4). The acquisition radar detects a target that is then designated to a target-track radar (TTR). The TTR locks on the target; tracks it; measures the range, azimuth, and elevation angle to the target; and continuously sends these data to the computer. A third radar, the missile-track radar (MTR), locks on the missile; measures its range, azimuth, and elevation angle; and continuously sends this information to the computer. Thus,

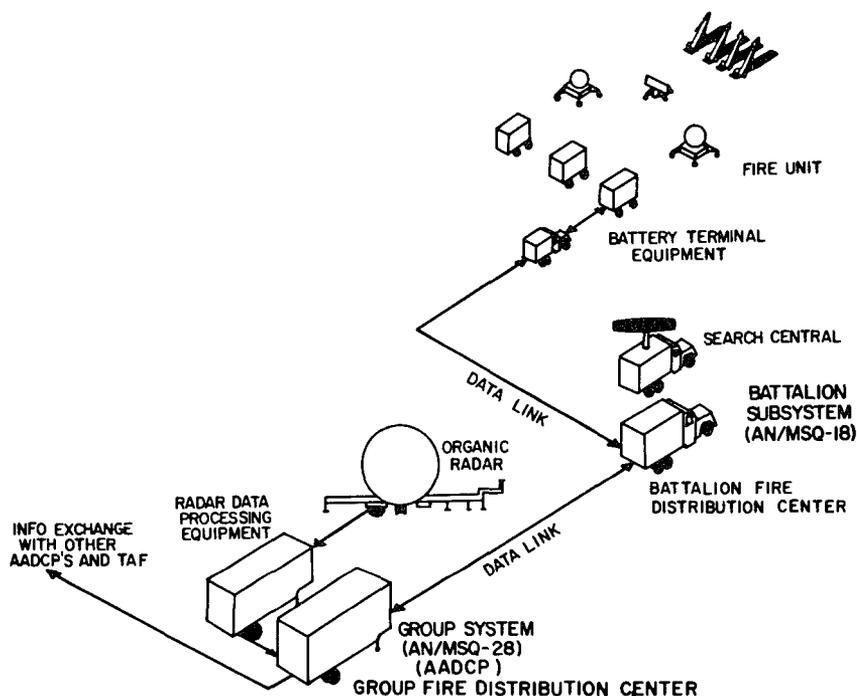


Figure 3. Fire distribution system AN/MSG-4 (Missile Monitor).

the electronic computer knows the location of the target and missile. Commands are transmitted through the MTR to continuously direct the missile to an intercept with the target. As the missile reaches the target, the computer commands the warhead to detonate.

b. **NIKE-AJAX.** The NIKE-AJAX is a two-stage supersonic missile using a solid propellant rocket motor (booster) and a liquid propellant missile motor (fig. 5). It is 33 feet long and weighs about 1 ton. The AJAX system was designed to destroy airborne objects having speeds of up to 1,100 knots and maneuverability of 3g at 40,000-foot altitude. The system's reliability and performance steadily increased through the experience of firing more than 4,000 rounds. A battery's rate of fire against a 450-knot target is approximately one round per minute. Sustained fire depends on the number of ready rounds available.

c. **NIKE-HERCULES.** The NIKE-HERCULES is a two-stage supersonic missile using a solid propellant rocket motor cluster

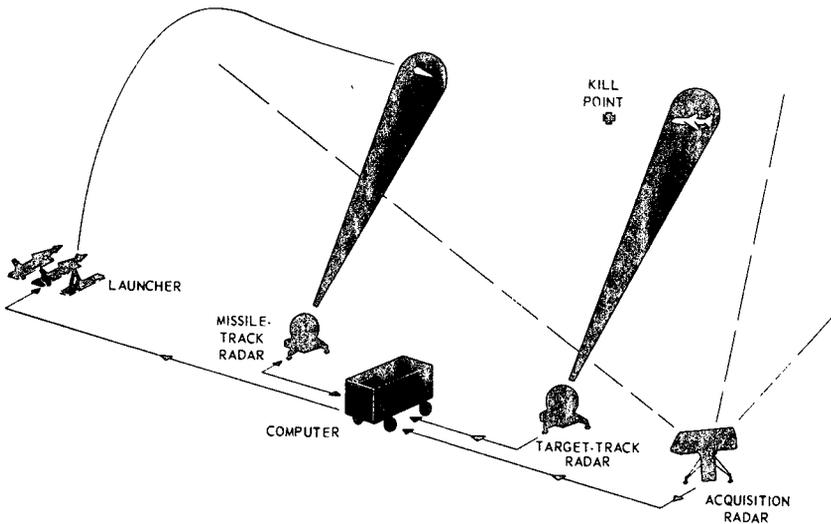


Figure 4. How NIKE works.

(booster) and solid propellant missile motor (fig. 6). It is 39 feet in length and weighs about 4 tons. A NIKE-HERCULES missile may be armed with either a nuclear or high explosive warhead. The NIKE-HERCULES system utilizes command guidance to achieve its deadly accuracy. The system normally functions as a part of an integrated defense; however, each battery has the capability of autonomous operation. HERCULES has demonstrated effectiveness against targets traveling at speeds in excess of mach 3 (2,100 MPH), at ranges exceeding 75 miles, and at altitudes greater than 150,000 feet. The NIKE-HERCULES system also has a highly accurate and extremely dependable surface-to-surface capability with a short reaction time.

(1) This is paragraph 3, FM 44-1A.

(2) This is paragraph 4, FM 44-1A.

d. Improved NIKE-HERCULES. The HERCULES ground guidance equipment has been modified to enable it to combat the smaller, faster, higher flying targets of the near future. This modified system is designated the Improved NIKE-HERCULES (INH). Improvements were made in the basic TTR, presenta-

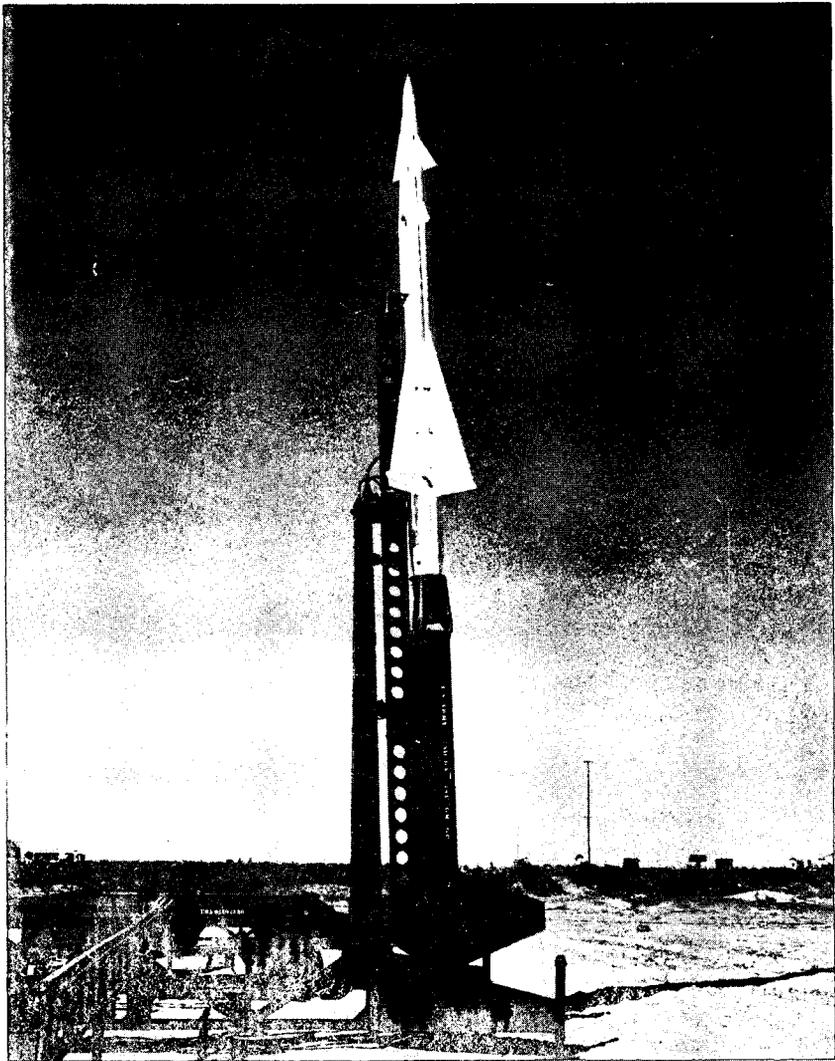


Figure 5. NIKE-AJAX missile.

tion system, and tactical controls, and a target-ranging radar (TRR) was added. In addition, either a high-power acquisition radar (HIPAR) or an alternate battery acquisition radar (ABAR) may be issued for use with INH to improve target acquisition.

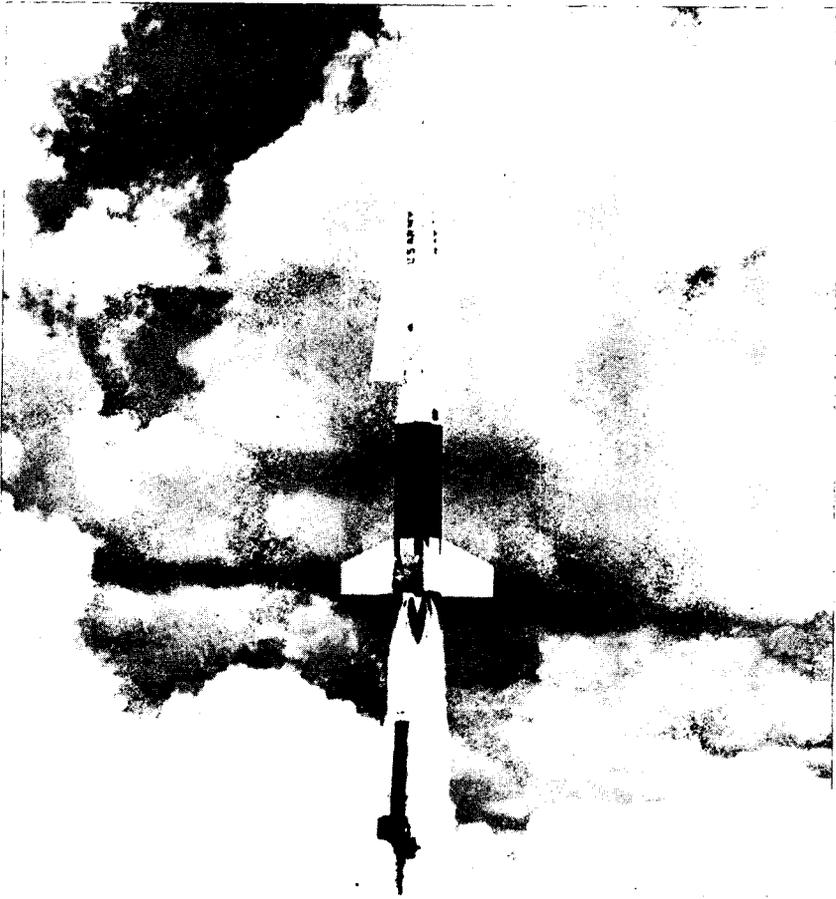


Figure 6. NIKE-HERCULES missile.

- (1) The HIPAR is capable of detecting small, fast targets at long ranges in an intense ECM environment. In addition, it provides simultaneous altitude coverage from the radar horizon to an altitude greater than can be attained by conventional aircraft-type targets of the present and foreseeable future. The acquisition radar of the basic HERCULES system is retained, thus providing a second acquisition capability.
- (2) The ABAR provides an increase in target detection range, a more favorable beam pattern, and a much im-

proved ECCM capability when compared with the standard HERCULES acquisition radar.

- (3) The TRR functions as a supplemental radar for the TTR and provides target range information in a high-density ECM environment. The TRR's outward appearance is identical to that of the standard TTR. However, this improved version incorporates many new circuits specifically designed to counter the future ECM threat.

e. NIKE-ZEUS. The NIKE-ZEUS is an antimissile missile system being developed to defend critical areas in CONUS against intercontinental ballistic missile (ICBM) attack. The system is composed of components that can be deployed in a building-block scheme. This modular design provides the flexibility to increase operational capabilities and tailor the NIKE-ZEUS battery to meet the requirements of the area to be defended.

7. HAWK Weapon System

a. The HAWK system is designed to cope with high-speed, low- and medium-altitude targets. An aircraft attacks at a low altitude to escape radar detection and penetrate a defense by taking advantage of the degradation to pulse-type radar caused by ground clutter. HAWK's continuous-wave radars and semiactive homing guidance are not affected by ground clutter. The HAWK is a highly mobile and flexible system, having extreme accuracy with a high rate of fire. This missile is approximately 17 feet long and weighs 1,295 pounds (fig. 7). It has a solid propellant missile motor and is armed with a high explosive warhead. All of the equipment of the system is either vehicular or trailer mounted, giving an excellent ground mobility. The HAWK system is air transportable by fixed-wing transport aircraft or transport helicopters.

b. The equipment in a HAWK battery includes a battery control central (BCC), a pulse acquisition radar (PAR) for medium-altitude coverage, a continuous-wave acquisition radar (CWAR) for low-altitude coverage, a range-only radar (ROR) to provide range information, two continuous-wave illuminator radars (CWIR) for tracking targets, and six launchers (fig. 8).

c. A target is detected initially with one or both of the acquisition radars. Following target acquisition, a CWIR tracks the target and "illuminates" it with electromagnetic energy. Target position information is fed to the BCC, and the decision is made to fire. After launching, the missile homes on the target by using the illuminator radar transmitted energy and the energy reflected from the target to determine guidance information.

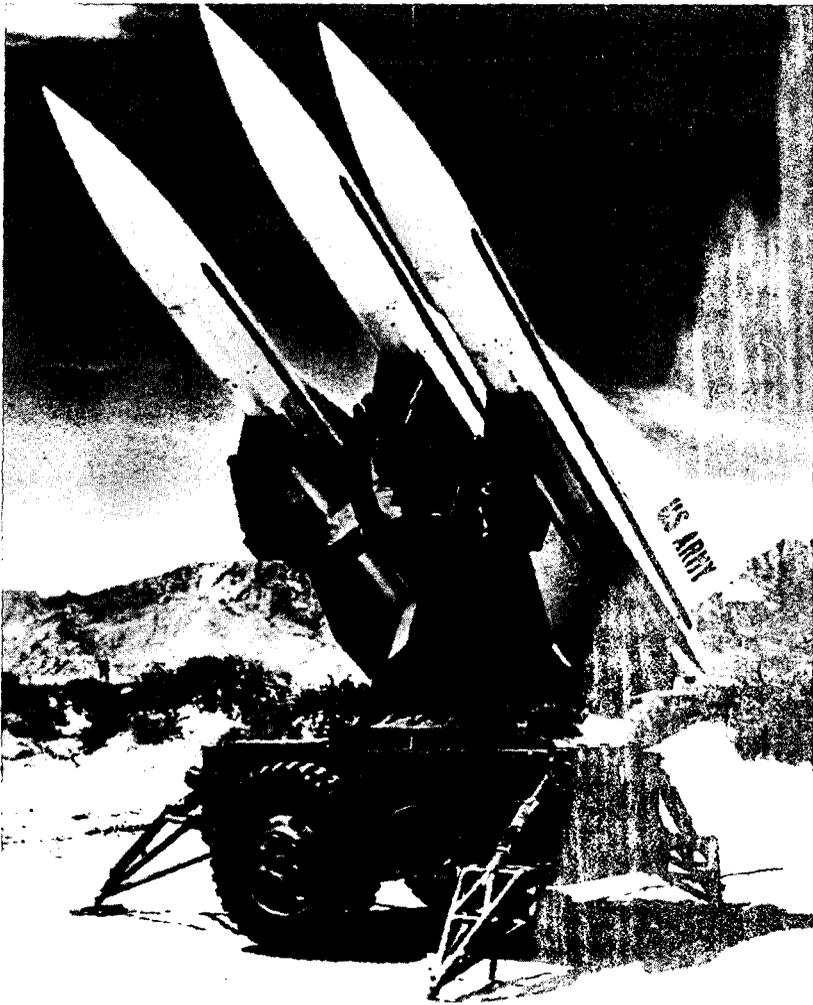


Figure 7. HAWK missiles on launcher.

d. The system is highly flexible, both in its means of attack and its method of employment. HAWK is effective against multiple aircraft attacks and widely separated targets because the battery, having two independent firing sections, can fire at two targets simultaneously. Although designed to meet the low-altitude threat, it also provides excellent defense at higher altitudes. When the situation dictates, a portion of the battery, called the assault fire unit (AFU), can be deployed rapidly to meet a specific threat.

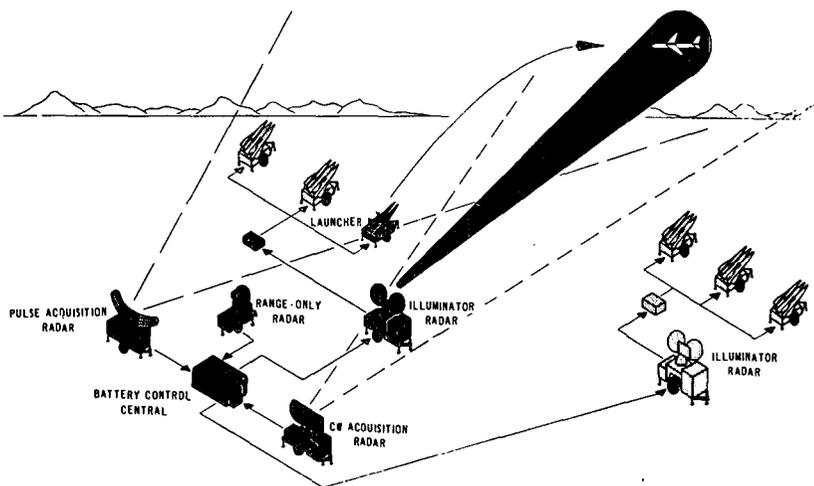


Figure 8. HAWK battery.

The basic AFU consists of an assault fire command console (AFCC), CWIR, loader transporter, generator, launcher, pallet with missiles, crew chief junction box, and necessary cabling. The AFCC is used to control the fires of the AFU. The basic AFU can be augmented with the CWAR, two additional launchers, and pallets with missiles.

8. Other Weapon Systems

a. General. Air defense missile systems capable of achieving denial of penetration of the defended area by hostile aircraft and cruise and ballistic missiles are replacing air defense gun systems. However, for completeness, air defense gun systems are mentioned as they are still included in the current inventory.

b. DUSTER Forward Area Weapon. The DUSTER forward area weapon (M42, self-propelled, twin 40-mm) is employed to provide air defense to the division area. Capable of a high rate of automatic fire, it can also be employed in the ground support role.

c. Light, Medium, and Heavy ADA. The 75-mm (Skysweeper), 90-mm, and 120-mm guns have been effectively replaced by the HAWK, NIKE-AJAX, and NIKE-HERCULES missile systems.

d. Appendixes. Appendix I lists references for air defense gun systems and appendix III contains information concerning their employment.

9. Future Weapon Systems

a. General. In addition to NIKE-ZEUS, missile weapon systems currently under development include MAULER, Field Army Ballistic Missile Defense System (FABMDS), and REDEYE.

b. MAULER forward area weapon system is being developed to provide air defense for the forward elements in a combat area against manned aircraft, drones, and tactical ballistic rockets. MAULER is a light, self-propelled air defense missile system that is both air-transportable and air-droppable. Designed to replace DUSTER, MAULER's mobility, target handling capacity, and capability against the air threat will provide major improvements in the air defense of the forward combat area.

c. FABMDS is being developed to defend the field army against the ballistic missile threat. The system will complement Improved NIKE-HERCULES and HAWK in the defense of the field army.

d. REDEYE weapon system is a small, shoulder fired, guided missile. It is an all-arms weapon designed to provide combat troops with the capability of destroying low-flying aircraft.

CHAPTER 3

ARMY AIR DEFENSE ORGANIZATION

10. General

a. The organization of AD headquarters and units is shown in detail in appropriate tables of organization and equipment. The composition, in terms of units, of AD echelons above battalion is flexible and is determined by the requirements of a specific situation. Brigade, group, and battalion organization charts are contained in appendix V.

b. Organization of AD units provides only a limited security capability. Local security for the position actually occupied is provided by the AD unit. Because AD operations are conducted on a continuous basis, AD units do not perform any other ground security mission. Area security must be provided for these units by the organization or headquarters responsible for area security. Security provided must be adequate to protect critical AD equipment that is extremely vulnerable to infiltration-type ground attack and sabotage.

11. Air Defense Battalion

a. The battalion normally is the basic administrative unit in air defense. It consists of a headquarters and headquarters battery and three or four firing batteries.

b. Some AD battalions are organized under special TOE's designed to meet particular requirements more economically.

- (1) The headquarters and headquarters battery may be reduced to a small command group for supervision of training. (Most of the administrative functions of the battalion are then assumed by an augmented group or battalion group headquarters.)
- (2) More than one type of firing battery may be assigned to an AD battalion. (The battalion headquarters and headquarters battery is augmented if additional personnel are required to provide adequate supervision and assistance to the firing batteries.)

12. Air Defense Battalion Group

One or more AD battalions may be attached to another battalion to form a battalion group. When an AD group headquarters

is not available or is not considered necessary, battalion groups are formed in order to achieve unity of effort and direction by providing one overall control headquarters for an integrated air defense of a designated area separate from other AD forces. The battalion group headquarters has generally the same functions as an AD group headquarters but will require augmentation in order to have the same capabilities as an AD group headquarters. The senior battalion commander is designated the battalion group commander.

13. Air Defense Group

The AD group consists of a group headquarters and headquarters battery and such units as may be attached. The purpose of the group is to provide tactical control and administrative supervision of two or more AD battalions. The group headquarters may be augmented with a part of the attached battalion administrative personnel and equipment to enable it to relieve attached battalions of administrative functions.

14. Air Defense Brigade

The AD brigade consists of a brigade headquarters and headquarters battery and such AD groups, battalions, and other units as may be assigned or attached. The mission of the brigade is to provide tactical control and administrative supervision of the AD units of a particular area when the area of responsibility and the number of AD units exceeds the capability of an AD group. A brigade will usually include two or more groups.

15. Army Air Defense Commands

The brigade is the highest AD echelon provided by standard TOE. When a higher AD echelon is required, it is provided by a special organization designed to meet the particular requirement. Such special organizations are usually designated Army Air Defense Commands. An Army Air Defense Command consists of a headquarters organization and such units as may be assigned or attached.

CHAPTER 4

AIR DEFENSE EMPLOYMENT PRINCIPLES

16. General

Air defense employment is based on the role of active air defense operations and their relation to offensive counterfirepower operations to attain air superiority. The active air defense system maintains responsiveness and maximizes weapon system capabilities through effective employment.

a. A military force has attained air superiority when it can conduct operations during a given time and at a specified place without prohibitive interference from the enemy air threat. Air superiority can be attained and maintained only by the efforts of both offensive counterfirepower and active defense operations.

- (1) The basic tasks of offensive counterfirepower in this role are to destroy the enemy air threat before it becomes airborne, to destroy bases and installations supporting the air threat, and to deny the establishment of other bases and installations that would support the air threat.
- (2) Air defense means are established to conduct active AD operations after the enemy air threat becomes airborne and also to assist in the accomplishment of the basic tasks of counterfirepower. In the field army, the surface-to-surface employment of certain AD weapons in this mission will increase the counterfirepower capability. AD coordination with other units participating in offensive counterfirepower operations will provide intelligence that may not only enable the destruction of an air threat after it becomes airborne but also enable an attack at its source.

b. The speed and firepower with which the enemy can attack through the air and his ability to select how, when, and where to attack dictate that the air defense system must respond rapidly with accurate, directed fire. When additional attacks are discovered, further distribution of fire must be made quickly. To accomplish this increased distribution, the air defense system must include adequate command supervision of AD fires and coordinate them with the other air defense forces available. The need for friendly forces to use the same airspace with a minimum of restrictions requires close coordination between all services.

c. The air defense fire unit is the smallest component that can independently detect, attack, and destroy a hostile aerial target. Air defense employment is essentially a problem of deploying fire units and coordinating their fires. The level of protection provided the various portions of a defended area should be proportional to their overall strategic or tactical value and the threat posed by the number of enemy delivery means capable of attacking these areas. Each defense must be established to maximize the capabilities of the weapon system against the expected conditions of attack.

d. The fundamental principles of air defense employment are to deny penetration and match the defense to the threat and to the vital area. The application of these principles is based on defense planning considerations, basic employment considerations, and weapon system considerations.

17. Fundamental Principles

a. *Denial of Penetration.* The primary objective of the establishment of an Army air defense is the denial of penetration of the defended area. In the present nuclear age when a single airborne object is capable of destroying a large area, the old concept of maximum attrition rate is inadequate. Defenses must be developed and operational procedures established that preclude hostile aircraft and cruise and ballistic missiles from reaching the point at which they can inflict damage to the vital area beyond the degree specified by the appropriate commander.

b. *Match the Defense to the Threat and to the Vital Area.* The air defense is based upon the enemy threat, the vital area, and the type of AD weapon systems employed.

- (1) *Enemy threat.* Type of attacking airborne object, attack techniques, number of targets, types of weapons used, and speed and altitude of attack.
- (2) *Vital area.* Size, shape, relative location, composition, vulnerability, criticality, military worth, and recuperability.
- (3) *Air defense.* Types of weapon systems, number required, optimum deployment, system characteristics, and types of warheads available.

18. Defense Planning Considerations

a. *Attack Assumptions.*

- (1) The determination of a defense being adequate or inadequate is based to a large extent upon the estimate

of the number of targets to be attacked simultaneously. The period of attack time is of a very short duration and requires simultaneous attacks by the enemy if he is to maximize the force of his onslaught. Intelligence sources can determine, with considerable reliability, the number of airborne objects in the enemy inventory, their operational characteristics, and depreciative factors. The number of vital areas the enemy must attack simultaneously if he is to succeed must be a factor for consideration. The number of airborne objects in the enemy inventory and the number that can reach our defended areas at any one time after the depreciating factors of mechanical failure, human error, weather, and kills by area air defense weapons are determined. This computed or assumed potential striking force must then be divided between the number of key areas (cities and installations) that the enemy must strike at one time in order to destroy the resources and retaliatory capabilities of the country. Determination of the most likely speed and altitude of attacks is made by considering the characteristics of enemy airborne objects. When this information is not known, the maximum capabilities are estimated.

- (2) Based on the different types of carriers that the enemy may have in an operational status, it can be assumed that he will attack with those that can best reach the target area in the desired number. The carriers employed will vary with numbers available, the payload, weather conditions, and launching base-to-target considerations. Closely associated with the characteristics of the carrier, launching base, and target area will be the attack technique. The enemy may employ high-altitude gravity drop bombing, boosted bombs, air-to-surface (ASM), low-altitude bombing system (LABS), or surface-to-surface missiles (SSM). These carriers may make a mass attack from one general direction or divide and strike several sides of the defense simultaneously. A mass attack from one general direction is most favorable to the enemy since AD units on the far side of the defense must fire over the vital area, therefore delivering fewer missiles prior to a target reaching the bomb release line (BRL).

b. Defense Characteristics.

- (1) The defense characteristic that will most influence the capability of our defense is a single-shot kill probability (SSKP) which is based on the lethality and accuracy

of our weapons. The SSKP will vary with the different air defense systems, the warhead (HE or nuclear), and the target (aircraft, missiles, or nuclear weapon). The SSKP is determined from actual firings, the design specifications, or both.

- (2) Notwithstanding the excellence of design and manufacture of a missile system, no product works perfectly 100 percent of the time or without breakdown. Operators of a machine or system will, from time, commit human errors. Furthermore, the appropriate commanders may place an item of equipment out of action for required maintenance or training. Computation of operational reliability (OR) is based upon the particular missile system, past operational records, the proficiency of training of the operating crews, and prevailing climatic conditions that may affect the reliability of the system.
- (3) Radar discrimination is the ability of radars to distinguish between multiple targets flying relatively close together. Where targets are so close together that discrimination is not possible, the radars will either hunt between several targets or the targets will appear on the screens as a single object.
- (4) The acquisition range of radars (based upon many factors: target altitude, target size, earth curvature, ECM degradation, etc.), target-track procedures, transfer time, and missile time of flight determine the system's maximum effective horizontal range. ECM degradation can be substantially reduced by the employment of radar operator techniques and the use of ECCM devices, which can be added to radar systems. For a discussion of the types ECM, proper operator techniques, and use of ECCM devices, refer to TM 11-750.

c. Command Specifications. Command specifications are set forth by the higher level commands and become requirements for the air defense planner. In CONUS these specifications come from NORAD.

- (1) Based on classified studies for the air defense of the United States, certain concentrations of population, industry, and military establishments must be protected if the nation is to retain its national defense production and retaliatory capabilities. The command making these broad strategic studies will specify which key areas must be protected and the priority for protection based on their importance in the national defense effort.

- (2) It is obvious that any critical area, whether a city, military base, or industrial center, can suffer some damage and still retain a very high degree of effectiveness as a part of the national defense effort. However, an area can accept just so many casualties or so much damage to industry if it is to remain alive and continue its key contribution to the national defense effort. The amount of damage that will occur to various cities or areas will vary with their density and configuration and the yield of the weapon detonated. The specified maximum acceptable damage will be defined by isodamage contour lines resulting in the definition of the vital area to be protected.
- (3) Based on the importance of a protected area, the responsible commander will specify the degree to which denial of penetration must be assured. Realizing that no military operation can be assured 100 percent success, the commander will specify an assurance comparable to the importance of the area being protected with full consideration being given to other air defense requirements. This degree of denial in turn results in a specified kill assurance. The higher the specified kill assurance, the more fire units required to furnish that degree of protection. The air defense planner will plan and design the defense accordingly, staying within the maximum allocation of units specified by the higher commander.

d. Step-by-Step Planning Procedures. Step-by-step planning procedures are contained in appendix II.

19. Basic Employment Considerations

Basic employment considerations for locating fire units in the design of an air defense are:

a. Balance. An approximately equal amount of firepower for all directions of attack.

b. Adequacy. A sufficient amount of firepower to deny penetration.

c. Weighted Coverages. A defense weighted toward probable directions of attack or toward high priority areas.

d. Defense in Depth. A defense which provides an increasing amount of firepower on a threat approaching the center of the defended area. Mutual support between missile units is realized in a defense in depth.

e. Routes of Approach. An avenue which enhances the attack

capabilities of the threat. This term is normally applied with reference to the low-altitude threat.

f. Early Destruction. A deployment of weapons well forward in the combat zone or far out from the vital area to increase the early-kill capability.

g. Position Requirements. The technical and tactical factors of a particular weapon system which must be satisfied to facilitate accomplishment of the mission.

h. Future Situation. A consideration of forthcoming improvements to the system, increased allocation of units, integration of forthcoming weapon systems, replacement by new weapon systems, increased attack characteristics by the enemy, changes in tactical disposition of friendly forces, and changes in location of defended areas.

20. Weapon System Considerations

Each AD weapon system is employed using only those basic employment considerations listed below that enhance the capabilities of that weapon. The basic employment considerations for NIKE-AJAX or NIKE-HERCULES weapon systems are the same in CONUS and COMMZ, but are different in the field army. For the HAWK weapon system, they remain unchanged regardless of where employed.

a. Basic employment considerations for NIKE-AJAX or NIKE-HERCULES weapon systems in CONUS and COMMZ:

- (1) Balance.
- (2) Adequacy.
- (3) Defense in depth.
- (4) Position requirements.
- (5) Future situation.

b. Basic employment considerations for NIKE-AJAX and NIKE-HERCULES weapon systems in the field army:

- (1) Weighted coverage.
- (2) Defense in depth.
- (3) Position requirements.

c. Basic employment considerations for the HAWK weapon system:

- (1) Early destruction along low-altitude routes of approach.
- (2) Defense in depth.
- (3) Position requirements.

PART TWO
AIR DEFENSE, CONUS
CHAPTER 5
AIR DEFENSE ORGANIZATION

21. General

Unified Action Armed Forces, JCS Pub 2, assigns to the Army the following air defense functions: To organize, train, and equip Army air defense units, including the provision of Army forces as required for the defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff. The combined command established to defend the continental United States, Canada, and Alaska against air attack is the North American Air Defense Command. The unified command established to perform air defense missions of a national nature is the Continental Air Defense Command. The command established to carry out the Army air defense mission is the United States Army Air Defense Command.

22. North American Air Defense Command (NORAD)

(fig. 9)

a. North American Air Defense Command (NORAD), is responsible to the United States Joint Chiefs of Staff (JCS) and the Canadian Chiefs of Staff Committee (COSC) for aerospace defense of the continental United States, Canada, and Alaska. The Commander in Chief NORAD (CINCNORAD), has *operational control* over all United States and Canadian Forces assigned, attached, or otherwise made available for aerospace defense. These component forces include: the U.S. Army Air Defense Command (ARADCOM), the U.S. Air Force Air Defense Command (ADC), U.S. Naval Forces NORAD (NAVFORNORAD), the Royal Canadian Air Force Air Defense Command (RCAF), and air defense forces of the Alaskan Command. Each component force provides combat ready air defense units to CINCNORAD for operational control; however, each of the component force commanders retains command, administrative, training, and logistical control over his respective force. The NORAD Sector is the basic combat operation control agency of NORAD. The sector commander exercises *oper-*

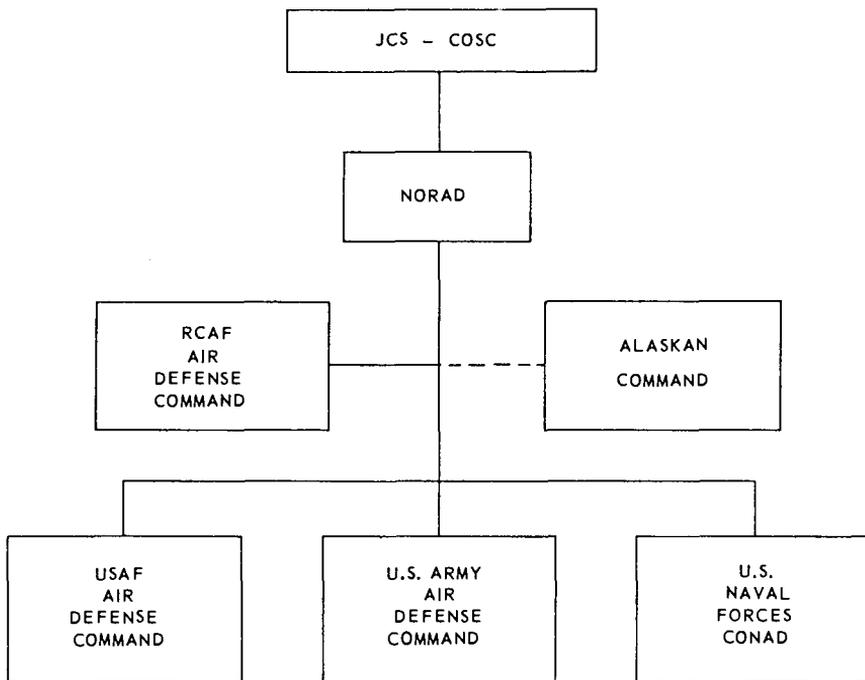


Figure 9. NORAD component commands.

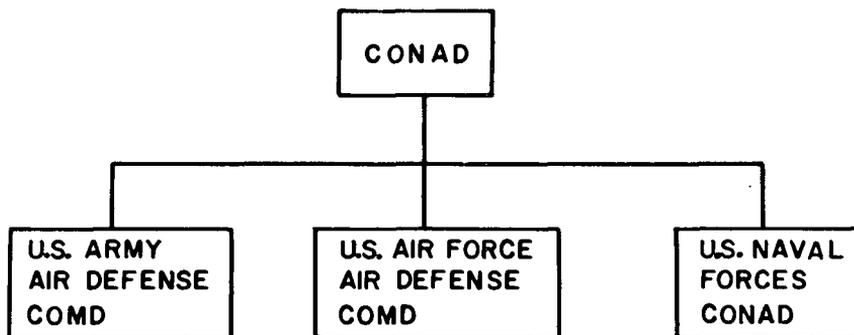


Figure 10. CONAD structure.

ational control over all air defense forces within his geographical area from the NORAD Sector Direction Center (NSDC).

b. By agreement between Canada and the United States, CINCORAD and his deputy may not be of the same nationality. CINCORAD has a combined command and exercises operational control over all NORAD forces. Staff directors have decision-making authority in their respective areas of responsibility. Staff positions are filled on the basis of capability and without regard to service affiliation.

c. NORAD prepares operational plans, conducts tactical exercises, and coordinates plans and requirements for new air defense weapons. More important, it conducts readiness tests of its units and will direct the air defense battle for North America in the event of war.

23. Continental Air Defense Command (CONAD)

(fig. 10)

CONAD is a unified command under the Joint Chiefs of Staff. It performs all air defense missions of a national nature. CINCONAD is the senior U.S. officer in Headquarters, NORAD. The CONAD staff accomplishes broad, overall national planning, while detailed planning is accomplished by the component service commanders. CINCONAD acts as a U.S. commander only and exercises operational command over all U.S. air defense forces in NORAD without duplicating the operational responsibilities of CINCORAD.

24. United States Army Air Defense Command (ARADCOM)

a. The senior U.S. Army organization in the NORAD structure is ARADCOM which commands, trains, and administers the U.S. Army air defense units of NORAD.

b. ARADCOM units defend major industrial and population centers of the United States as well as selected Strategic Air Command (SAC) bases. NIKE-AJAX and NIKE-HERCULES sites are manned by ARADCOM personnel in CONUS and Greenland. In addition, National Guard units man NIKE-AJAX sites within CONUS.

c. Administrative and training supervision over the widespread defenses of ARADCOM is diversified by the establishment of area commands (regions). Figure 11 indicates the region boundaries of ARADCOM. ARADCOM Region headquarters are located as listed below:

(1) Headquarters 1st Region, Fort Totten, N.Y.

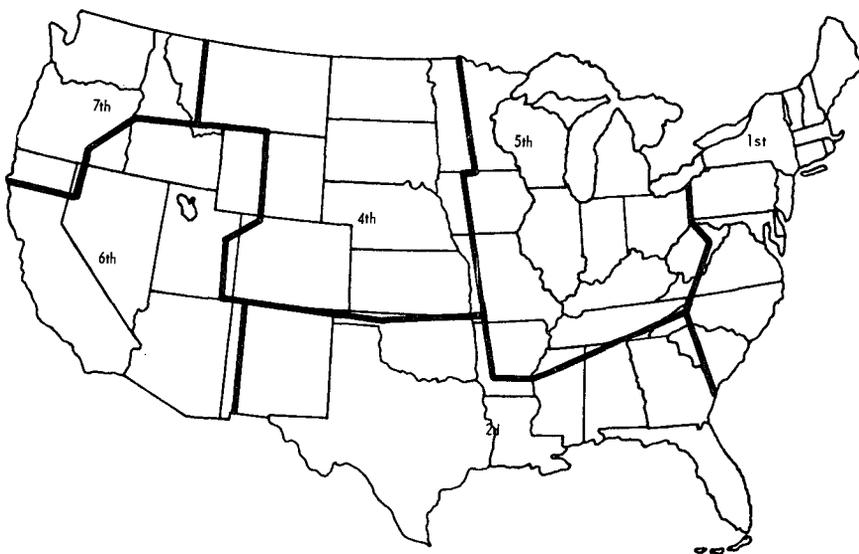


Figure 11. ARADCOM regions.

- (2) Headquarters 2d Region, Oklahoma City, Okla.
- (3) Headquarters 4th Region, Richards-Gebaur Air Force Base, Mo.
- (4) Headquarters 5th Region, Fort Sheridan, Ill.
- (5) Headquarters 6th Region, Fort Baker, Calif.
- (6) Headquarters 7th Region, McChord Air Force Base, Wash.

d. Army air defense command posts (AADCP) are established for each defense at battalion, group, or brigade level. From the AADCP the Army air defense commander exercises *operational control* over all Army fire units within his defense. For normal operations, the AADCP is under *operational control* of the

NORAD Sector Direction Center; however, for *command*, the AADCP is directly subordinate to the ARADCOM region commander.

e. The Army philosophy of control of AD units is to delegate to the *lowest practical level the authority to act*, while preserving at the *highest practical level the ability to coordinate*. The result is maximum reaction to an enemy threat in a minimum of time. For an AD engagement, the fire unit commander is supplied information on which to base his decisions, and he is delegated authority to act. Only infrequently should it be necessary for an AD commander to exercise his authority to override the combat decision of AD commanders at subordinate echelons.

CHAPTER 6

AIR DEFENSE OPERATIONS

Section I. DETECTION AND IDENTIFICATION

25. General

Aerial target detection and identification information is collected, processed, and disseminated as air defense intelligence. The rapidity of action in active air defense operations requires close integration of detection, identification, and dissemination facilities. The provision of adequate, timely, reliable, and continuous air defense intelligence is the backbone of an air defense system and is the function of the air defense intelligence system. The reduction of the overall active air defense reaction time to a minimum requires integration of the detection facilities to permit rapid coordination and dissemination of air defense intelligence, operational instructions, and other pertinent information by automatic data systems. The air defense intelligence system consists of NORAD early warning detection facilities, NORAD aerospace facilities, NORAD surveillance facilities, Army acquisition facilities, and identification means.

26. NORAD Early Warning Detection Facilities

(fig. 12)

The early warning network of the air defense intelligence system provides for early detection of hostile airborne objects and timely warning of their approach. This allows time for the alerting of active air defense means and for their attaining higher conditions of readiness. In addition, early warning allows time for other agencies to execute offensive counterfirepower operations and to implement passive air defense plans and aircraft control and dispersion plans.

a. The detection phase begins with the Distant Early Warning (DEW) Line. This radar fence across the northern rim of the continent in the Canadian Arctic and Alaska provides warning against attack by the manned bomber. The DEW Line is operated jointly by the U.S. and Canada. The U.S. Navy and U.S. Air Force provide sea flanks for the DEW Line by extending coverage with radar-equipped aircraft operating from the Aleutians to mid-Pacific and from Newfoundland to mid-Atlantic.

b. Behind the DEW Line, some 600 miles south, lies a second detection system, the mid-Canada Line that uses doppler detection equipment. It was built and is manned by Canada.

c. A third warning net, a system of radars built and operated jointly by the U.S. and Canada, is set along the U.S.-Canadian border and is now a part of the contiguous coverage within the U.S. and Canada.

d. South of these lines is a network of radars within the United States (including long-range radars tied into the semiautomatic ground environment (SAGE) system). The U.S. contiguous radar system is extended offshore by the U.S. Navy picket ships and U.S. Air Force radar-equipped aircraft. In the Atlantic, USAF radar platforms (Texas Towers) are part of the system that is tied together by a communication network terminating in the NORAD command post, the combat operations center.



Figure 12. NORAD early warning detection facilities.

27. NORAD Aerospace Facilities

To fulfill its mission of defending against aerospace attack, NORAD employs—

a. BMEWS, the USAF-operated Ballistic Missile Early Warning System. Its purpose is to warn against missiles attacking North America over the polar regions. All data from BMEWS are fed directly to Headquarters, NORAD, and are relayed to strategic striking forces.

b. SPADATS, the Space Detection and Tracking System that is under operational control of CINCNORAD and consists of SPACETRACK and SPASUR.

c. SPACETRACK, officially named the National Space Surveillance Control Center, was established by the USAF for the purpose of analyzing and cataloging satellite orbital data that it receives from SPASUR and other sources.

d. SPASUR, a satellite detection system that was developed and is operated by the U.S. Navy for the Advanced Research Projects Agency, is assigned to the operational control of NORAD. By setting up electronic and radar devices that cover certain regions of space, the Navy's detection "fence" can discover, identify, and predict the orbit of any satellite that may penetrate it.

28. NORAD Surveillance Facilities

a. The surveillance radar networks of an air defense intelligence system are essential to insure—

- (1) Continuous location of hostile targets approaching defended areas.
- (2) Acquisition of targets at maximum ranges by various weapon system acquisition and fire control radars.
- (3) Effectiveness of active air defense firepower against all hostile targets.

b. Prime radars are located throughout the NORAD sectors to provide radar information directly to the semiautomatic ground environment (SAGE) direction center (DC). The long-range radar sites use the AN/FST-2 data-transmitting equipment to accept radar returns, process target information, and transmit digital data to the DC where it is automatically entered into the DC computer.

c. Gap filler radar sites, using the AN/FST-1 data transmitting equipment, supplement the coverage of the long-range radars by providing similar data to the DC.

29. Army Acquisition Facilities

Army air defense units have organic acquisition radars. The primary function of acquisition radars is local target detection. The additional function of providing air defense intelligence is gained by the netting of these radars with the overall air defense intelligence system.

30. Identification Means

Identification is one of NORAD's most difficult problems, caused chiefly by the large amount of air traffic in the United States and Canada. On the average, there are 600 overwater flights incoming to the U.S. and Canada every day, plus an estimated 200,000 internal flights.

a. Air defense identification zones (ADIZ) are established to aid in identification and recognition. Such zones are located throughout NORAD. Any aircraft penetrating an ADIZ from outside must do so within an established distance of a preindicated point and within 5 minutes of a preestimated time. If the aircraft fails to meet these minimums, it is declared unknown and must be visually identified by an interceptor. The ADIZ system is part of the NORAD identification process known as flight plan correlation. United States and Canadian civil aviation control agencies provide flight plan information to the NORAD agency that has responsibility for identification. At these NORAD facilities, tracks are established and flight plan correlation performed.

b. To aid identification, many methods and techniques have been studied. The primary Army technique uses identification friend or foe (IFF) equipment and a new addition, the selective identification feature (SIF). The SIF, when added to the basic IFF equipment, provides many codes that can be assigned to specific commands or aircraft.

c. Under combat conditions, the identification process would be somewhat simplified when provisions of the emergency plan SCATER are placed in effect. SCATER (Security Control of Air Traffic and Electronic Radiations) provides for the orderly grounding of nonessential aircraft, and for the establishment of military control over radio navigational aids. CONELRAD (control of electromagnetic radiations), another emergency plan, provides for control of radio and television broadcasts that could give navigational assistance to enemy aircraft.

31. General

a. In discharging its mission, NORAD is governed by these air defense principles: Hit the enemy as far out as possible; increase the pressure if he continues to come in; complicate his tactical problem by employing a family of weapons to perform the low, medium, high, close-in, and distant missions; and realize the optimum economy and efficiency of effort through centralized control of the entire air battle.

b. The NORAD operational facilities and operational procedures established in accordance with these principles are described below.

32. NORAD Operational Facilities

(fig. 13)

The NORAD command post is the combat operations center

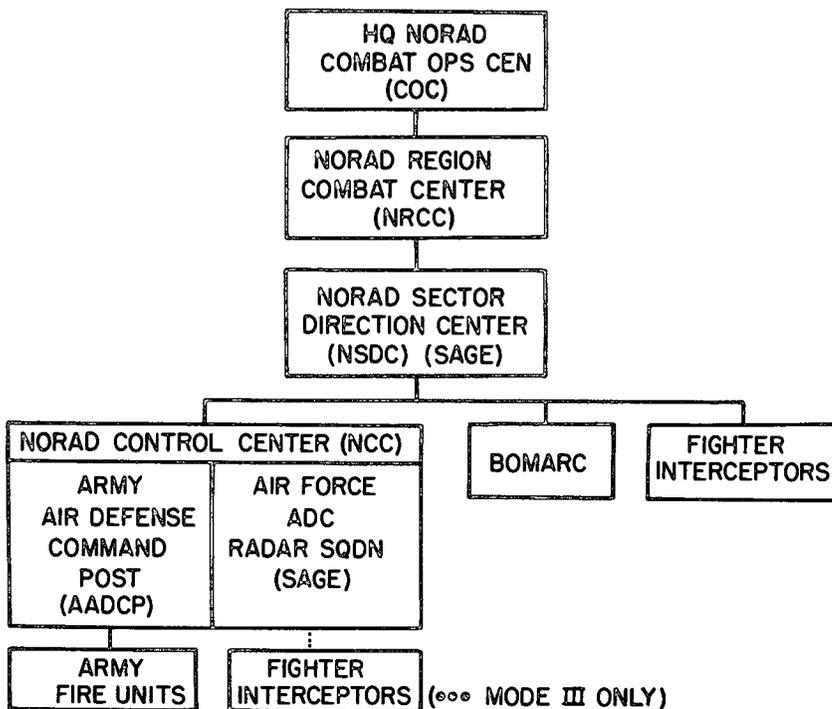


Figure 13. NORAD operational facilities.

(COC). NORAD is divided into regions. Each region has as its command post a NORAD region combat center (NRCC). The regions are divided into sectors; a sector is the basic NORAD unit for fighting the air battle. For operational control of each sector there is a NORAD sector direction center (NSDC). The NORAD control center (NCC) is established subordinate to either region or sector. The Army air defense command post (AADCP) links each Army air defense to NORAD.

33. Semiautomatic Ground Environment (SAGE)

a. The conduct of an area air defense battle requires a great deal of information, dependable communications, and coordination among many organizations. A USAF electronic air surveillance and weapon control system (SAGE) was devised to do the job.

b. The flow of SAGE data in the air defense organization is portrayed in figure 14. Its computer receives data automatically and continuously from prime radars and, on demand, from height-finding radars. Air movement information, weapon status, weather reports, airborne early warning, and picket-ship radar tracks are received by telephone, radio, and teletype and manually programmed into the computer by punchcard systems. Similarly, data from the DC are transmitted automatically to scramble manned interceptors and to direct unmanned interceptors and those manned interceptors equipped with data link receivers to the hostile aircraft. Digital data transmission is used to pass hostile track information to AADCP's equipped with semiautomatic FDS's for action by ADA fire units. Selected data are automatically sent to adjacent DC's and to NRCC. Manned interceptors not equipped with a data link are directed to the hostile aircraft by voice radio (UHF). Telephone, teletype, and radio are used to pass information to manual AADCP's, civil defense agencies, SAC, and other headquarters.

c. The Army air defense brigade and group TOE augmentation provides the personnel for the air defense artillery director (ADAD) team at NSDC, SAGE. The principal function of the ADAD team is to coordinate and monitor the track and fire unit information flow between the DC and AADCP.

(1) The ADAD team is provided the following facilities in the DC weapons room:

- (a) A console containing a situation display (SID), digital-information display (DID), and selective push-buttons and necessary telephone facilities.
- (b) An auxiliary console with DID and telephone facilities.

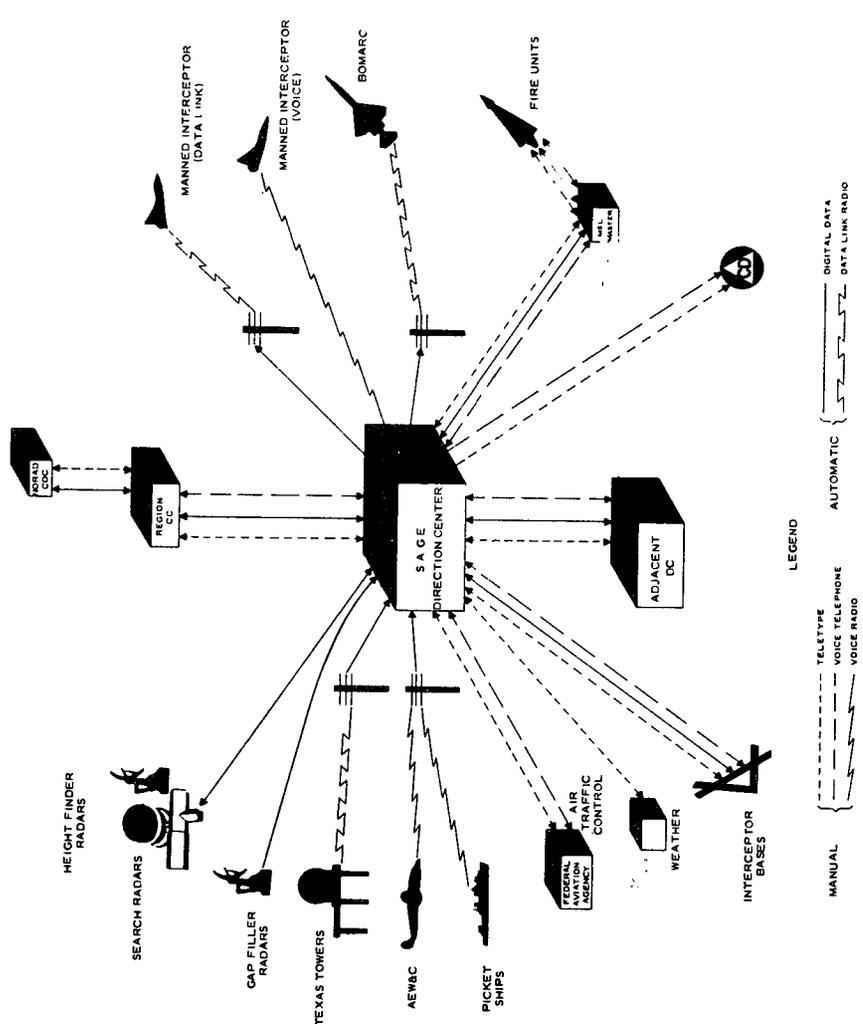


Figure 14. SAGE data flow.

(2) The following doctrine of operation for the ADAD is prescribed by NSDC:

- (a) The ADAD monitors tracks passed to the AADCP. By use of voice telephone lines, he notifies his AADCP of changes in weapons control status and conditions of air defense warning.
- (b) The ADAD must insure that the AADCP is informed of appropriate tracks.
- (c) The ADAD and manual inputs supervisor must keep the electronic computer informed of changes within the assigned AADCP so that displays throughout the DC are current and complete.

34. Army Air Defense Command Post (AADCP)

The tactical headquarters of the Army air defense commander is the Army Air Defense Command Post (AADCP). The AADCP collects information on the air situation, performs evaluation, improves data received by use of organic radars, and disseminates air defense intelligence. The commander utilizes the facilities of the AADCP to exercise supervision, command, or *when necessary*, operational control over individual batteries in the defense in response to instructions received from the NORAD headquarters. The AADCP utilizes the FDS, AN/FSG-1 (Missile Master); FDS, AN/GSG-5(V) (BIRDIE); or the FDS, AN/GSG-6() (BIRDIE). Missile Master and BIRDIE systems receive information from SAGE and transmit other information back to SAGE by digital data links.

35. NORAD Operational Procedures

In SAGE sectors where Missile Master or BIRDIE are operational, NORAD has prescribed four modes for SAGE-Army AD operation.

a. Mode I. The SAGE DC exercises operational control over all air defense forces within its sector with two options available:

- (1) *ATABE (automatic target and battery evaluation) option.* Specific target-to-battery assignments are made by the DC.
- (2) *Reference data (decentralized) option.* Target information is passed to the AADCP for appropriate action and battery assignment.

b. Mode II. When a SAGE DC becomes nonoperational for any reason, adjacent DC's assume control of the disabled sector by expanding their areas of responsibility. (The ATABE and refer-

ence date options are used by these DC's when operating with Army AADCP's, and these operations are specified as mode II.)

c. Mode III. In the event that two adjacent SAGE DC's become nonoperational or other situations develop that preclude or seriously degrade mode I or II operation, NCC commanders will assume control of their specified areas at the direction of NORAD sector or region commanders. In those areas where there is no NCC, the AADCP will employ Army AD weapons by exercising either centralized or decentralized control.

d. Mode IV. When the AADCP loses communications with its associated NORAD agency, it will operate autonomously. When the fire unit loses communications with its associated AADCP, it will operate autonomously. In autonomous operation the defense commander or the fire unit commander assumes full responsibility for the conduct of air defense operations by his unit.

36. AADCP Operational Procedures

AADCP's automatically receive early warning, aircraft identification, and other data from associated SAGE direction centers (DC's). These data are collected by the AADCP, improved when possible, and transmitted to the fire units. Measures to control fire unit operations include weapon control status, air defense warning, special weapons control instructions, defense readiness conditions, states of alert, and weapons control status case. Sample forms and reports pertaining to air defense operations are contained in appendix IV.

a. The weapon control status that governs the engagement procedures for fire unit is—

CENTRALIZED:

Direct target to fire unit assignments are made either by the NSDC (SAGE), the NCC, or the AADCP, and the fire unit engages only designated targets. *This mode should be used only when there are few hostiles in the defense system.*

DECENTRALIZED:

This is the normal AADCP mode of operation. In this mode the fire unit selects targets for engagement in accordance with established rules for target selection. The

AADCP furnishes target information on all hostiles and monitors fire unit actions to insure the overall effectiveness of the defense. Assignment of specific targets to individual fire units usually should not be required.

b. *Air defense warning* is an appraisal of the probability of attack and is expressed as—

- | | |
|-----------------|--|
| WARNING RED: | Attack by hostile aircraft or missiles is imminent or in progress. |
| WARNING YELLOW: | Attack by hostile aircraft or missiles is probable. |
| WARNING WHITE: | Attack by hostile aircraft or missiles is not considered immediately probable or imminent. |

c. The following terms will be used to issue *special weapons control, engagement, and disengagement instructions* for specific airborne objects:

- | | |
|-------------------|--|
| HOLD FIRE: | Do not open fire; cease firing. Missiles in flight will be destroyed. Fire units will cease tracking the target. |
| CEASE FIRE: | Refrain from firing on an airborne object. Missiles in flight are permitted to continue to intercept. Fire units will continue to track the hostile. |
| CEASE ENGAGEMENT: | Disengage the specified track and prepare to engage another. Missiles in flight will be permitted to continue to intercept. |

d. *Defense readiness conditions (DEFCON)* are the means used to maintain the defenses at a state of preparedness compatible with the real or apparent imminence of attack. These defense

readiness conditions are declared or terminated by CINCNORAD or by other specified authority (ref. NORADR 55-3).

e. States of alert are the means used by the Army AD commander at the AADCP to prescribe the readiness of fire units in the defense. The state of alert is initiated in response to the defense readiness conditions (DEFCON) announced by the NORAD commander.

f. Weapons control status case to control the employment of types of warheads is prescribed by command directives.

Section III. COMMUNICATIONS

37. General

a. The control and coordination of AD must facilitate its immediate response as part of an overall, coordinated air defense system. It is dependent upon effective high-speed communications. Communications between the various command posts and with service elements is required for normal command and administration.

b. Reliable, high-speed communications is an important factor in effective and timely distribution of AD fires. The air defense commander must rely on his communications system for air defense warning, and for control and coordination of the operations of the units of his command. The communications nets essential to an air defense are described in appropriate field manuals in the 44-series.

38. Communications Responsibility

a. Commercial communications facilities are used in ARADCOM between AD units and defense AADCP's and between AADCP's and NORAD sector direction centers. Organic Army communications facilities normally are used for intra-area communications in the AD units.

b. The commander of each AD echelon is responsible for the installation, operation, and maintenance of the Army communications facilities of his command. He is responsible that appropriate personnel of his command are adequately trained in the use of the various means of communications. The communications officer of each AD unit exercises immediate supervision over the operation and maintenance of the unit's communications facilities.

39. Communications Discipline and Security

The speed required in processing firing data and the volume of message traffic handled make an orderly system of procedure necessary. Message brevity and net-operating discipline are necessary in both wire and radio communications. No electronic transmission means is considered secure. Classified messages are encoded or encrypted prior to transmission by radio or other electronic means unless authorization to be sent in clear has been given. Cryptographic security means include various types of codes and ciphers as well as electronic cipher devices. Personnel must be thoroughly familiar with the practice of security measures.

40. Communications Instructions

a. Signal Operation Instructions (SOI) are combat orders issued periodically for the technical control and coordination of signal communications within a command. They include items subject to frequent change covering codes and ciphers, radio call signs and frequencies, a telephone directory, and visual and sound signals. The SOI is prepared by the signal/communications officer, conforms to the tactical SOP of the unit, and is compatible with the SOI of the next higher organization.

b. Standing Signal Instructions (SSI) contains information on the use of items in the SOI as well as items not subject to frequent change. These instructions are prepared by the signal/communications officer.

41. Communications Requirements

a. SAGE DC and Manual AADCP Communications. Communications between NSDC SAGE and manual AADCP provide early warning by teletype, and operational control and liaison by voice. The manual AADCP receives radar reporting from defense acquisition radars and provides information to the fire units. Communications are maintained with adjacent AADCP by liaison.

b. SAGE DC and Missile Master AADCP Communications. Communications between NSDC SAGE and Missile Master provide early warning by teletype; track data and control by automatic data link (ADL); and additional operational control and liaison by voice. Missile Master receives radar reporting from defense acquisition radars. Missile Master provides communications with fire units by command and intelligence voice nets and for the exchange of track data and control information by ADL. A voice net is provided for maintenance of the ADL's.

c. NORAD Sector (Manual) and Manual AADCP Communications Communications between NORAD sector (manual) and manual AADCP provide information exchange by voice circuits. NCC provides early warning, status information, and operational control. Defense acquisition radars provide radar information to the AADCP. Identification for radar information can be requested from the NCC over a radar reporting net. Manual AADCP provides information to the fire units. A command net from the AADCP to fire units is provided for control. Liaison is maintained with adjacent AADCP's.

PART THREE
AIR DEFENSE, THEATER OF OPERATIONS
CHAPTER 7
ORGANIZATION, RESPONSIBILITY, AND MISSION

42. General

a. Theater armies may operate in a wide variety of environments. These environments may vary from a comparatively undeveloped theater of operations to a highly developed theater and from the use of nonnuclear forces to general nuclear war. Extremes in environment, magnitude, and character of military operations and the availability of AD means require that AD doctrine, organization, and employment be sufficiently flexible to meet any contingency.

b. In the interest of national security, the President of the United States, through the Secretary of Defense and the Joint Chiefs of Staff (JCS), may establish a specified or unified command in a strategic area and prescribe the mission of the commander in an approved plan of operations. This strategic area is referred to for joint usage as an *area of operations* and for Army usage as a *theater of operations*. A *specified command* normally is composed of forces from but one service. A *unified command* contains component forces from more than one service. A *combined command* includes assigned forces from more than one nation. The provisions contained in this manual pertain to a U.S. unified command; however, principles of employment for AD apply to other types of commands and task forces.

43. Theater of Operations Organization

(fig. 15)

The unified commander is the theater of operations commander. The composition of forces assigned is dependent upon the mission, objectives, and projected type of operations. The theater commander is assisted by a joint staff, if forces assigned consist of two or more service components. Each component force commander is responsible to the theater commander for the tactical employment of his component force.

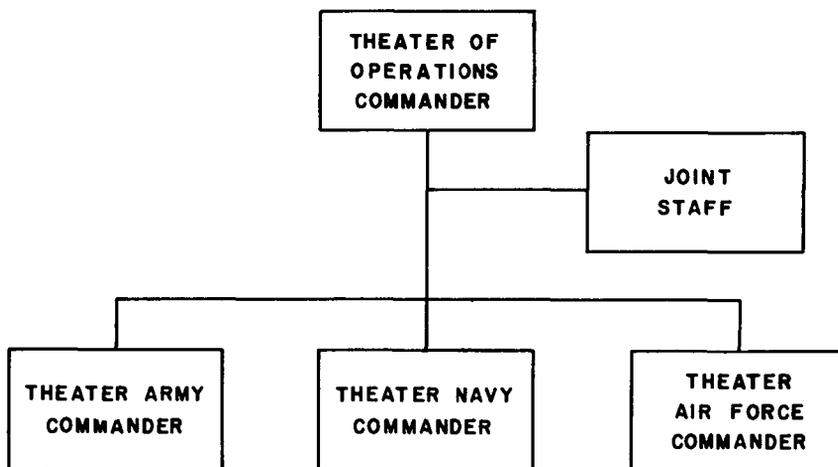


Figure 15. Theater of operations command organization.

44. Theater Air Defense Responsibility

The theater commander is responsible for the air defense of the theater as a whole, for AD priorities, and the allocation of AD means.

a. Priorities are based on the tactical situation, importance of operations, and the vulnerability and recuperability of units and vital areas.

b. Allocation of AD means is based upon priorities and includes all AD forces assigned or attached.

c. Policies established for AD will be included in theater operational plans as standing operating procedures (SOP). The AD SOP should include but not be limited to :

- (1) Rules for establishment of conditions of AD warning.
- (2) Rules for engagement.
- (3) Rules for establishment, change, and cancellation of various modes of air traffic control.
- (4) Guidance in the use of nuclear and electronic warfare by AD.
- (5) Guidance for an AD intelligence network.

45. Theater Army Mission and Organization

The mission of the Army forces assigned to a theater of operations is to plan and execute sustained land-combat operations, either independently or in conjunction with other service components. A theater army consists of Theater Army Headquarters (TAHQ); Theater Army Air Defense Command (TAADC); Theater Army Logistical Command (TALOG); Theater Army Civil Affairs Command (TACAC); and both combat and service units assigned to field army(ies) (fig. 16). Two or more field armies are assigned to an army group for tactical control.

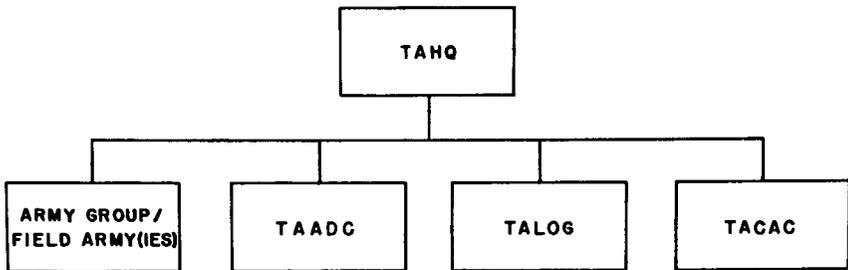


Figure 16. Theater army organization.

CHAPTER 8

COMMUNICATIONS ZONE (COMMZ)

Section I. THEATER JOINT AIR DEFENSE COMMAND (TJADC)

46. General

a. The theater commander establishes the TJADC in accordance with principles stated in Unified Action Armed Forces, JCS Pub 2. The commander of the TJADC exercises the authority of the theater commander in the coordination of all AD forces within the theater and establishes the theater AD coordinating procedures.

b. The authority establishing the TJADC designates the commander, the area to be defended, and the theater air defense priorities; allocates the means for conducting the defense; and states the mission of the command. The commander of the TJADC will apportion tasks of the mission to subordinate service AD force commanders. Each service AD force commander is responsible for the tactical employment of his forces subject to the operational control of the commander of the TJADC and operational procedures established by the theater commander.

47. Organization

(fig. 17)

The organization of the TJADC is based on the responsibilities, missions, and tasks assigned to the commander; the nature and scope of the operation; estimated hostile capabilities; and the characteristics and service identity of the forces allotted. The TJADC headquarters is established and joint staff organized to accomplish the planning for the air defense of the COMMZ and the coordination of all AD within the theater including the field armies. The forces provided for the air defense of the COMMZ are allotted to the TJADC, and the commander of the TJADC exercises operational control over the allotted AD forces through the service force commanders. This operational control is limited to the AD forces provided for the air defense of the COMMZ and does not extend to the AD forces with the field army(ies).

48. Operations

In the accomplishment of its mission, the TJADC must plan

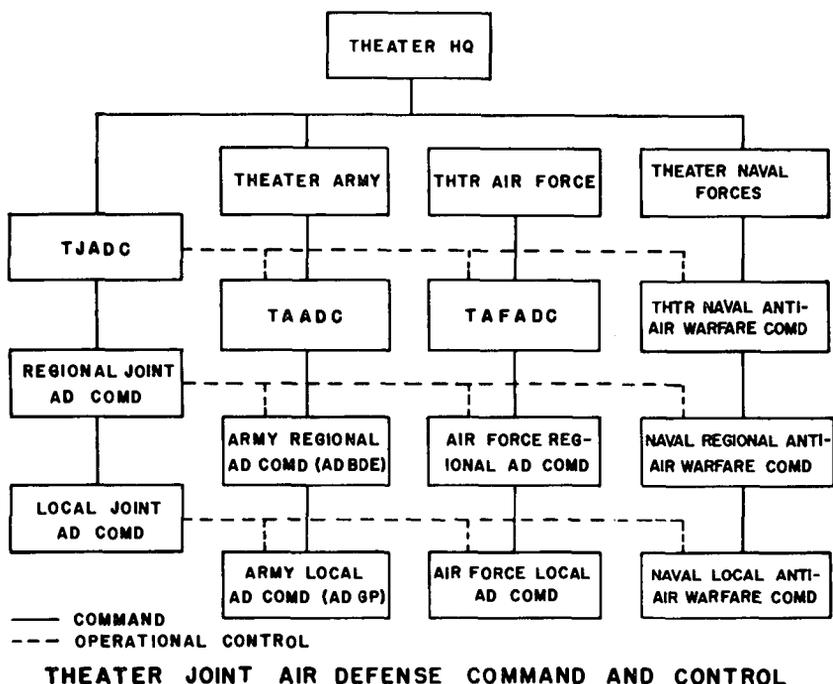


Figure 17. TJADC organization.

operations that are compatible with present theater operations and that are in consonance with planned theater operations. JCS-established doctrine and policy provide for the planning for unified operations and training and for the control and coordination of assigned forces. Joint training exercises may be required to achieve effective employment of the forces and to provide for the establishment of such policies for joint operations as are required to accomplish the mission. Intelligence activities must be established and coordinated to provide for the rapid and widespread collection and dissemination of AD intelligence. This intelligence activity will require extensive separate AD communications channels utilizing the theater area communications system and organic communications equipment. Modes of operations and control measures are established by the TJADC to facilitate the exercise of operational control over the COMMZ air defense forces.

49. Air Defense Intelligence Considerations

a. Aerial target detection and identification information is collected, processed, and disseminated as air defense intelligence.

b. TJADC responsibility for establishing an AD intelligence system is inherent in, and inseparable from, the responsibility for establishing an air defense. Following the guidance of the theater commander, the commander of the TJADC establishes a theater-wide system using the AD intelligence means of all services operating in the theater so as to insure complete and rapid exchange of information about hostile or unidentified flights.

c. TJADC coordinates the deployment of the detection facilities of all services, including those in the combat zone, to insure complete theater coverage. The defense acquisition radars are deployed in coordination with the overall radar network. Planning factors include siting defense acquisition radars in relation to the radars of other services operating in the area. This coordination will provide for the earliest possible warning of low-flying attackers, continuous and complete coverage, and avoidance of duplication of effort.

50. Air Traffic Regulation and Identification

a. The establishment of procedures for air traffic regulation and identification is necessary to insure maximum effectiveness of active AD means and to provide protection of friendly aircraft from friendly AD fire. Responsibilities and operational procedures for air traffic control and identification within the theater of operations are established by the theater commander. Responsibility and procedures for identification of aircraft and authority to disseminate a track as hostile will be as prescribed by the theater commander through the TJADC.

b. The tactical air force (TAF) tactical air control system is a communications and electronic organization assigned to each TAF to provide rapid communications between forces engaged in tactical operations, radar air surveillance of the TAF area, and a system for in-flight control of USAF tactical aircraft and missiles.

c. The Army air traffic control system is established to expedite the safe and orderly flow of Army air traffic under all flight conditions, assist the AD intelligence system in identification of Army aircraft, and provide air warning and in-flight assistance. Field army and corps commanders are responsible for the establishment and operation of the air traffic control and navigation systems. The air traffic control system must operate closely and continuously with the AD system. This is facilitated by the proximity of the Army flight operation center (FOC) to the AADCP. Where coordination with other services is necessary to avoid confusion and duplication, the Army aviation officer at the appropriate headquarters will establish such liaison.

Section II. THEATER ARMY AIR DEFENSE COMMAND (TAADC)

51. General

The theater army commander establishes a TAADC on the same command echelon as TALOG, TACAC, and the army group(s)/field army(ies). When a TJADC is established, TAADC is placed under its operational control. Sufficient organizational flexibility is provided to enable TAADC to assume the mission of the TJADC when so directed by the theater commander. The TAADC is a major subordinate command of theater army and is established to command all Army AD means in the COMMZ. TJADC exercises operational control over the TAADC and Army AD in the COMMZ. The commander of the TAADC establishes and maintains his headquarters in the immediate vicinity of the TJADC headquarters. The TAADC headquarters staff is organized to accomplish the following:

a. Perform detailed planning functions in accordance with TJADC policies and procedures. The number, types, and organizational relationship of AD units assigned or attached will depend upon the mission, size of forces, configuration of the theater, and tactics and capabilities of the enemy. The exact organization must always be tailored to the resources available and the specific configuration of the theater of operations.

b. Possess liaison capabilities as required for the accomplishment of the mission and to insure integration of AD planning into supported force operations. Direct liaison with the TJADC, theater army, TALOG, field army ADA brigades, and tactical air force (TAF) is essential. TAADC liaison with field army ADA brigades, other theater AD commands, and AD commands of Allied powers will provide operational compatibility. Liaison with TALOG will provide the high-level flexible administrative support required by the AD units of the TAADC. Liaison with commands such as base or advanced logistical commands will facilitate AD support of their operations.

c. Represent the TAADC at the TJADC on a continuous basis and coordinate the development of AD policies and broad plans.

52. Organization

a. TAADC.

- (1) The TAADC is the senior Army AD headquarters in a theater of operations. Its function is to provide the theater army commander with an agency through which he can discharge his responsibility for COMMZ AD by assigned Army forces. It is capable, with augmentation, of operating as the TJADC.

- (2) The TAADC, in addition to the functions described in (1) above, serves as a planning headquarters to facilitate the integration of Army AD capability into overall theater and theater army planning. Liaison with other army, theater, and allied headquarters is established as needed to further this phase.
- (3) The TAADC participates in planning for the administrative support of Army AD units. Thus TAADC establishes liaison with TALOG as required.
- (4) The organization of the TAADC can vary widely, dependent upon the theater and the operational environment within which it will function, and may command varying numbers of Army AD units ranging from several brigades to merely one or two battalions. For this reason, the organization of the TAADC is flexible (fig. 17).

b. Army Regional AD Command. When the area of responsibility or the number of units allotted exceeds the capability of an ADA group, an ADA brigade will establish a regional command. The brigade AADCP exercises tactical control of its subordinate units under the operational control of the Regional Joint AD Command.

c. Army Local AD Command. When the area of responsibility and the number of units allotted is within the capability of an ADA group, it will establish a local command. The group AADCP exercises tactical control of its subordinate units under the operational control of the Local Joint AD Command.

53. Operational Planning

a. The TAADC determines the organization for combat of the Army AD means allotted. This organization facilitates the employment of missile units in consonance with the COMMZ air defense plan.

b. The defense is established to deny penetration by hostile aircraft and missiles into the airspace of the theater of operations or occupied portions thereof. The most effective employment is mutually supporting AD fire units deployed in depth. Defense planners must integrate both the active and passive AD means available into initial operational planning. The various areas to be defended are established in accordance with announced priorities. The latest specific attack threat estimates pertaining to the number and types of enemy aircraft and missiles, tactical formations, type of armament, yield of deliverable nuclear weapons, attack altitude and speed analysis, and attack techniques including bomb release distances should be studied. The maximum accept-

able damage that may be sustained in each defense area must be determined. It is expressed as the percentage of that area that could be neutralized and still permit the occupying installations and organizations to accomplish their assigned missions. This concept assumes, *for planning purposes*, a uniform distribution of installations and organizations in the defense area.

c. The AD organization is extremely flexible from the operational viewpoint. As the situation demands, attachments and detachments to different echelons of command can be made promptly. Should portions of the defense become inoperable, AD operations based on maximum decentralization can continue at the reduced level. The fire units must possess the authority to conduct AD operations when communications with higher echelons is disrupted. SOP will specify the conditions for target engagement by fire units under these circumstances with consideration given to the minimal identification capability they possess.

54. Air Defense Priorities

The theater of operations commander establishes the theater air defense priorities. These priorities normally specify air defense of such areas and installations as command posts, nuclear delivery means, logistical commands, tactical forces, and civilian facilities and industries. The TJADC establishes air defense priorities for the COMMZ in consonance with the theater air defense priorities. To insure adherence to these priorities, the TJADC requires coordination by all service air defense commands in the preparation of the COMMZ air defense plan. This plan provides for an integrated defense. Coordinated planning of the Army AD means is accomplished by the TAADC. AD priority criteria include:

a. *Selection.* The determination of areas most necessary to the accomplishment of the overall mission and the consideration of areas that are a source of United States or Allied military or economic strength.

b. *Assailability.* The enemy's ability to hit a particular installation.

c. *Vulnerability.* The degree of susceptibility of a particular installation to damage from a given type/weight attack.

d. *Recuperability.* The ease and speed with which an installation can be restored after being damaged or destroyed by enemy attack.

55. Planning for Counterguerrilla Operations

a. Passive counterguerrilla operations are designed in conjunc-

tion with the local security plans of the AD unit. The plan must provide for the protection of the unit's personnel and installations from enemy guerrilla raids.

b. Effective measures include the use of listening posts outside the defense perimeter, barbed wire entanglements, minefields, booby traps, trip flares, and the use of sentry dogs at night. In addition to the manned perimeter defense, a ready reserve is organized for immediate employment against a guerrilla raiding party. The ready reserve should be made up of off-duty personnel or of on-duty personnel whose duties will allow their absence during short periods without restricting the unit in accomplishing its AD mission.

c. Training of air defense personnel must stress individual weapon proficiency, crew-served weapon training, and hand-to-hand combat. Training in small-unit tactics is required to insure organization and control of those portions of the AD unit used against guerrilla actions.

d. Information concerning enemy guerrilla action should be reported to the appropriate area security control agency as well as through AD channels. Active counter guerrilla operations by area security elements require all information available to effectively counter enemy guerrilla forces.

e. Consideration should be given to Army aviation capability to provide rear area security and participate in counter guerrilla operations through the media of armed aerial vehicles.

56. Air Defense Intelligence Considerations

a. Aerial target detection and identification information is collected, processed, and disseminated as air defense intelligence.

b. The TAADC establishes procedures for exchanging AD intelligence with other services to complement the overall intelligence network plan by TJADC. Detection data is collected primarily by radar. Electronic computers aid in the rapid evaluation of this data. Instantaneous dissemination of AD intelligence is dependent upon adequate, full-time data transmission circuits. Those circuit facilities necessary for AD must be planned and coordinated for inclusion in the area communications system. In addition, pre-designated alternate routes should be provided for the transmission of these data. In the absence of electronic computers and data transmission systems, manual plotting of targets and voice telling of AD intelligence is used. Manual plotting and voice telling communications systems should be established parallel to the electronic systems to provide an alternate AD intelligence network.

c. The rapid dissemination of identification of friendly and hostile aircraft and missiles to the AD fire units is accomplished through the FDS, AN/MSG-4 (Missile Monitor). This system provides the electronic data processing and display equipment for the AD commander's staff to distribute current information and AD intelligence and to exercise operational control over the fire of all integrated AD units. The symbols appearing on the various displays are marked electronically to identify friendly and hostile aircraft and targets being tracked by other fire units.

57. Communications Considerations

The FDS components require communications facilities between each echelon to exchange information throughout the system. Consequently, extremely reliable full-time tactical communications must be provided by the theater area communications system. The communications platoon of the composite support company provides the internal communications for the AD headquarters, the internal communications for the fire distribution equipment, and the communications to tie in with attached units and area communications centers. The TAADC headquarters requires internal communications between staff sections, special circuits when designated an alternate headquarters for TJADC, and external communications to subordinate AD units, TJADC, THQ, TAHQ, and AD agencies of other services and allies.

CHAPTER 9

COMBAT ZONE (CZ)

Section I. FIELD ARMY AIR DEFENSE

58. General

a. The field army commander has an indivisible responsibility for all military operations in and over the field army area (which includes enemy-held territory to a depth designated by higher headquarters). He will be provided with means and authority commensurate with this responsibility, including weapons and forces to defend against air attack. The field army commander retains full control of the organic air defense means of his area, subject only to the theater commander's operational procedures, and those coordinating procedures prescribed by the joint air defense commander. The field army commander is responsible for control and regulation of the airspace over the combat zone. Operations by other services in this zone must be coordinated with the Army. The following principles govern the control and regulation of the airspace over the combat zone:

- (1) The undeniable right of all services to operate in the airspace over the combat zone must be recognized.
- (2) Coordination procedures must be based upon the principle of minimum restrictions to operating forces, with the corollary that reasonable risks in regard to self-inflicted damage must be accepted.
- (3) Each service must be responsible for the internal coordination of its own forces and weapons.
- (4) Interservice coordination must recognize that the Army has primary responsibility for operations, and conducts the major portion of activities, in the combat zone, including the airspace above it.

b. The nature of air defense operations and the innate characteristics of air defense artillery weapons, ECM systems, and aircraft make it necessary to consider all landbased ECM units and tactical air force air defense elements as contributing to the field army air defense system. Specifically in the fields of supervision of engagement, intelligence, and communications, all air defense units in the field army will be developed into an integrated and highly coordinated system to insure their effectiveness. The

field army ADA brigade commander is designated in orders as the field army air defense commander, and is responsible solely to the field army commander for the active air defense of the field army area.

59. Chain of Command

a. Army air defense of the CZ is provided by the air defense units allotted to the field army(ies). The TJADC exercises no command authority over air defense units organic, assigned, or attached to the field army; however, as the theater air defense coordinating authority, consultation is required between all services and agencies concerned with specific air defense activities and functions. Coordinating procedures are prescribed through the authority of the theater commander.

b. There is no direct AD chain of command from the TAADC to AD in the CZ. The field army commander must retain full control of the air defense of his area subject to the coordinating procedures established.

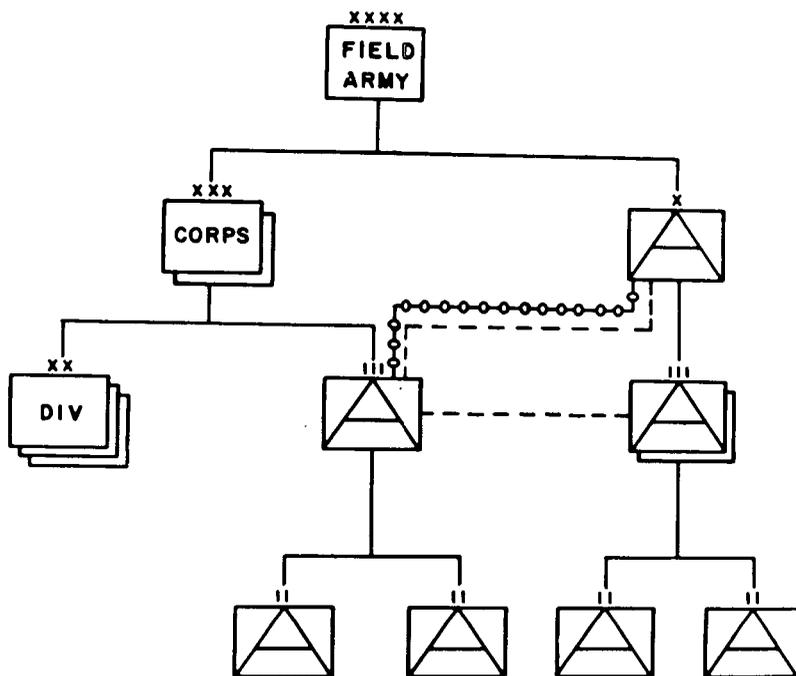
c. There is no direct AD chain of command from field army to corps and from corps to division. Instructions for corps AD are issued to the corps commander in the name of the field army commander. Similarly, instructions for division AD are issued in the name of the corps commander. In engagements, however, the AD commanders at all echelons effect direct and full coordination of all AD action and intelligence.

d. At field army, corps, and division levels, the force commander assigns priorities, allocates AD weapons, and prescribes operating and coordinating procedures. The senior AD unit commander in the force commands all AD means not further attached to subordinate forces and exercises coordinating authority for AD matters over all elements of the forces. He continuously monitors the AD situation for the force commander and acts for him during an engagement by exercising overriding authority over all Army AD means with the force.

Section II. ORGANIZATION

60. General

a. *Army air defense* units allocated to the CZ by the theater commander are further allocated to the field armies by the army group commander. AD units are not normally retained under the command of the army group commander. This field army must be able to defend itself, not only to permit it to carry on with its



- COMMAND
- COORDINATION
- o-o- OVERRIDING AUTHORITY WHEN REQUIRED FOR THE AIR DEFENSE OF THE FIELD ARMY

Figure 18. Air defense organization, field army.

combat operation mission but in this nuclear age as a *matter of survival*. To defend itself against all forms of attack, including air attack, the Army *must have the means and the authority* to accomplish this task. Army AD weapon systems give the field army the AD means. The authority, including control of the airspace over the field army, must be considered as an inherent command responsibility of the field army commander.

b. *Field army air defense* consists of an ADA brigade headquarters and headquarters battery and AD units assigned or attached to the field army and retained under the command of the brigade commander. *Air defense with the field army* includes field

army AD and AD of the corps and divisions subordinate to the field army (fig. 18).

c. Corps air defense consists of one or more ADA group headquarters and headquarters batteries and AD units assigned or attached to the corps and retained under the command of the designated corps air defense commander (the senior ADA group commander). *Air defense with the corps* includes corps AD and AD units attached to the divisions subordinate to the corps.

d. Division air defense will be provided by one or more ADA battalions attached to the division. Other air defense means within a division will include the all-arms employment of the REDEYE weapon system.

61. Army Group Air Defense Officer

The senior AD officer of the army group special staff is the army group air defense officer. The air defense officer, assisted by AD personnel assigned to the air defense section—

a. Determines the number and types of AD units required by the forces of the command including special equipment requirements.

b. Makes recommendations pertaining to the allocation of AD units.

c. Advises the army group commander and his staff on matters pertaining to AD and coordinates such matters with theater agencies and other services.

d. Coordinates with appropriate agencies of the Army and with other services on matters pertaining to the detailed control, regulation, and utilization of the airspace over the force.

e. Coordinates the active *air defense with the force* to insure its maximum effectiveness consistent with the mission.

f. Provides for coordination and exchange of AD intelligence between the TJADC, TAADC, and field armies and publishes AD information and intelligence.

g. Determines AD ammunition requirements and recommends allocation.

h. Advises on AD procedures and capabilities in the employment of nuclear weapons.

62. Field Army Air Defense Officer

The ADA brigade commander is the field army air defense officer. As a field army special staff officer he—

a. Advises the field army commander on matters pertaining to AD.

b. Coordinates with appropriate agencies of army group, field army, and other services on matters pertaining to the control, regulation, and utilization of the airspace over field army.

c. Establishes the air defense element (ADE) of the Field Army Tactical Operations Center (FATOC) and, through the ADE, insures the coordination of AD operations with other field army tactical support operations.

d. Insures coordination of field army AD operations with the TJADC, TAADC, and the air defense elements of other services.

e. Determines requirements for AD units and makes recommendations for their allocation to subordinate corps.

f. Recommends, through coordination with G3 and G4, the special ammunition load for AD units.

g. Coordinates the active AD of the command to insure maximum effectiveness and consistency with the mission.

h. Coordinates and insures the timely exchange of AD intelligence between AD units of the command and with army group.

i. Prepares the field army AD plan.

j. Prepares the field army AD SOP based upon the theater SOP.

k. Prepares and exercises staff supervision of training programs for AD with the field army.

l. Provides statistical data and operational reports of field army AD and consolidates after action reports by AD with the field army.

63. Corps Air Defense Officer

The ADA group commander with corps is the corps air defense officer. As a corps special staff officer he—

a. Advises the corps commander on matters pertaining to AD.

b. Coordinates with the field army air defense officer and appropriate agencies of the Army on matters pertaining to the control, regulation, and utilization of the airspace over the corps.

c. Establishes the air defense element (ADE) of the corps tactical operations center (CTOC) and, through the ADE, insures the coordination of AD operations with other corps tactical support operations.

d. Determines the requirements for AD units and makes recommendations for their allocation to subordinate divisions.

e. Recommends, through coordination with G3 and G4, the special ammunition loads for AD units.

f. Coordinates the active AD of the command to insure maximum effectiveness and consistency with the mission.

g. Coordinates and insures the timely exchange of AD intelligence between AD units of the command and with field army.

h. Prepares the corps AD plan.

i. Prepares the corps AD SOP based upon the field army SOP.

j. Provides statistical data and operational reports of corps AD.

k. Consolidates and forwards after action reports by AD with the corps to the field army air defense officer.

64. Division Air Defense Officer

The division air defense officer is the senior commander of AD units attached to division. His duties are similar to those of the corps air defense officer. As a portion of the AD with the corps, division AD intelligence and operations must be coordinated with the corps air defense officer in order to integrate the division AD into the overall AD system.

65. Air Defense Artillery Brigade (Group) Commander

Whether the AD brigade (group) is operating in the COMMZ, field army or with an independent task force, certain basic duties and responsibilities remain the same for the commander. He is responsible for the tactical operations and administrative supervision of all units assigned or attached. Specific duties are—

a. The tactical employment and deployment of AD units.

b. The establishment and operation of required Army Air Defense Command Posts (AADCP).

c. The timely issuance of necessary immediate operational instructions.

d. The preparation of brigade (group) plans and SOP based upon the theater (field army) SOP.

e. The supervision of brigade (group) training.

f. The establishment of necessary higher, lower, and adjacent liaison.

g. The preparation and rendition of required reports.

66. Air Defense Artillery Battalion Group Commander

Two or more ADA battalions with like missions in a defense area may be designated to form a battalion group to facilitate the span of control. The ADA battalion group commander is designated by the establishing authority. He will have the same general duties as a group commander in addition to commanding his own battalion.

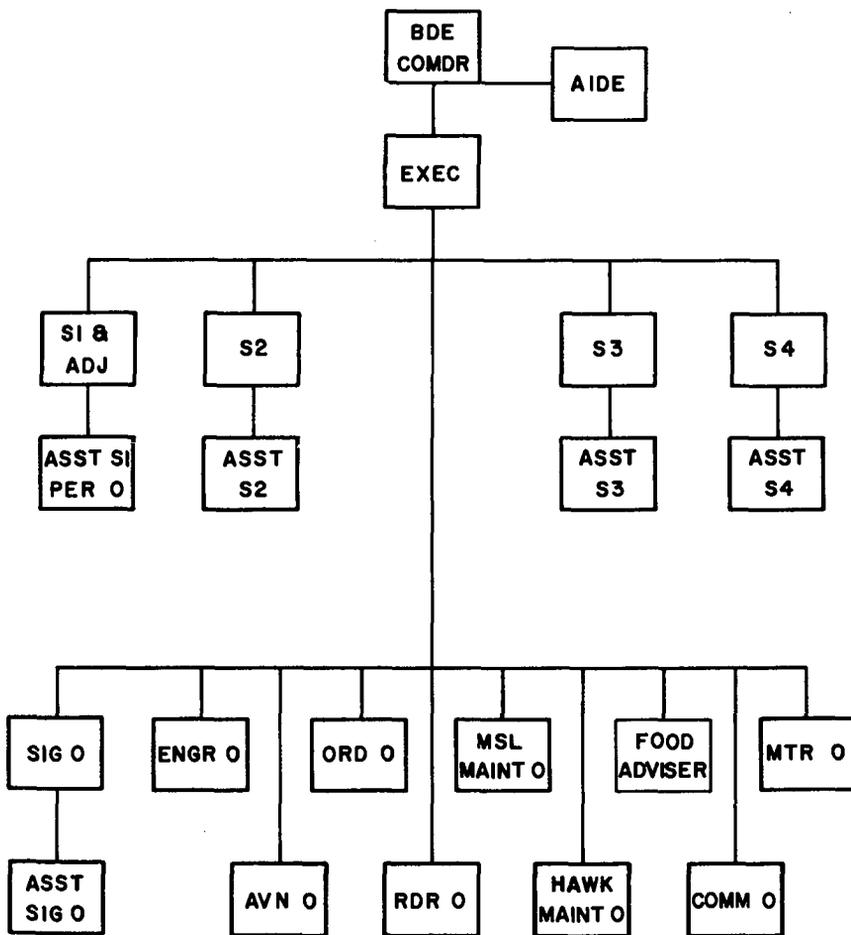


Figure 19. Typical organization, ADA brigade staff.

67. Air Defense Staffs
 (figs. 19 and 20)

The duty of the staff is to assist the commander in the discharge of his command responsibilities. The organization and functions of the AD staff are flexible and may be varied by the commander. The duties of AD staff officers conform to the principles and procedures in FM 101-5. Other specific duties are—

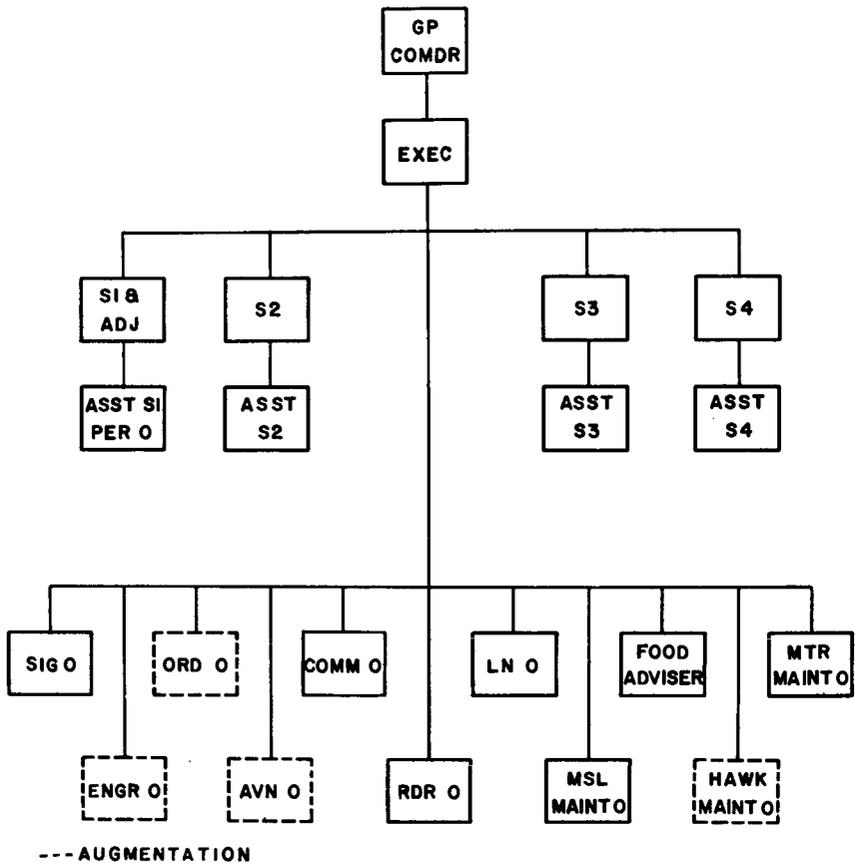


Figure 20. Typical organization, ADA group staff.

a. *Executive Officer.* Coordinates and supervises the establishment of local security, the establishment and operation of the AADCP, and unit displacement and march columns.

b. *S2.* Provides information and intelligence of the enemy air and surface situations, placing emphasis on enemy capabilities; coordinates with the S3 in planning liaison to exchange AD intelligence; and furnishes information for identification and recognition of aircraft.

c. *S3.* Designs and analyzes the air defense; operates the AADCP through the operations officer of the augmented AADCP

platoon (electronic or manual); recommends the assignment and attachment of AD units; and prescribes the states of alert.

d. Communications Officer. Plans and supervises the installation of communications for the AADCP and the headquarters.

e. Radar or Electronics Officer (Integrated Fire Control Officer). Supervises the maintenance of radar and fire control equipment and the preparation of radar clutter and coverage diagrams.

f. Missile Officer. Advises the commander and staff on missile matters.

68. Air Defense Units

The organizational structure, mobility, and type of weapon influence the assignment or attachment of AD units to the field army, corps, and division echelons of the overall AD system. TOE organizational charts of the ADA brigade, group, battalions, and batteries in the field army are contained in appendix V.

Section III. PLANNING

69. General

The AD means required by field army are based on the recommended AD priorities and the requirement to achieve denial of penetration by the estimated attack threat. Considerations to determine the AD units required include type and number of weapon systems, ammunition supply rates, special ammunition loads, and the allocation of nuclear weapons. The recommended AD unit requirements are reviewed by the G3 in relation to other troop requirements and incorporated in the troop list recommended to the field army commander. The AD commander advises the G3 on the capabilities of the AD units and recommends their allocation. The AD commander recommends to the G3 the allocation of nuclear weapons for air defense missions, and after coordination with the G4, recommends to the G3 the special ammunition load for air defense units.

70. Organization for Combat

Organization for combat places each AD unit in a tailored tactical organization. The AD units allocated to the field army are assigned or attached to the field army, corps, and division echelons to fulfill the AD mission, obtain maximum use of AD weapons, and integrate the AD means at each echelon into the overall AD system. The considerations basic to the attainment of these objectives are—

- a.* Present situation.
- b.* Future plans of operations.
- c.* The enemy threat.
- d.* AD priorities.
- e.* The defense area.
- f.* The AD plan.
- g.* The principles of tactical AD employment.
- h.* AD weapon capabilities.
- i.* The number of AD units available.
- j.* The AD unit mobility.
- k.* AD position requirements.

71. Estimate of the Situation and AD Priorities

The AD commander, as the field army AD staff officer, must maintain a current estimate of the situation and determine requirements for air defense. G2 intelligence estimates of enemy capabilities for attack by aircraft and missiles and the area of operations analysis provide the groundwork for planning the defense. G3 provides the field army commander's guidance, decision, and concept of operations pertinent to AD operations and priorities. Considering recommendations by subordinate AD commanders and the degree of air superiority achieved by the Army and other services, the AD commander reviews the AD priorities. The defended area protection, proportional to its overall strategic and tactical value, is planned, and priorities for point and area defenses are determined. The AD priorities are coordinated with other appropriate staff officers to insure they provide the necessary air defense of installations and activities. The AD commander submits the recommended priorities to G3 for review and further recommendation to the field army commander.

72. AD SOP

In conformity with the rules of engagement prescribed by theater, the AD commander recommends field army rules for engagement to G3. Through coordination with G2, target identification procedures are integrated, in consonance with the rules of engagement, into the AD SOP and coordinated with other Army and other service agencies using the airspace over field army. G3 provides guidance for the conditions under which AD nuclear weapons may be used. This guidance is prescribed in detail in the AD SOP to include responsibilities, controls, and specific considerations for nuclear employment by the AD unit. Appropriate portions of the AD SOP are coordinated with the rear area security

control staff officer to provide compatibility with the rear area security and damage control plans. Required AD intelligence and radar reporting procedures are prescribed. The conditions of AD warning, states of alert, weapons control instructions, and other control and limiting measures are included. The AD SOP is reviewed and published by G3 as an annex to the field army SOP. See appendix IV for a suggested form for the AD annex to a field army SOP.

73. AD Plan

The AD commander prepares the AD plan from the established priorities, allocation, SOP, and defense requirements. The plan is coordinated with the G3 to insure that the operation can be logistically supported and with field army staff and other Army agencies and other services operating in or over the field army area. The plan includes AD intelligence, mission, concept of operations, priorities, allocation, organization for combat, coordinating measures, and necessary administrative instructions for AD with the field army. G3 reviews the AD plan and submits it to the field army commander for approval. The AD plan is published as an annex to the field army operation order. Planning to provide the best possible air defense under all conditions must be continuous. With each change in the situation, the AD commander must reexamine all considerations involved and determine necessary changes to the plan. Techniques for the preparation of estimates, plans, orders, and SOP's are presented in FM 101-5. See appendix IV for suggested forms and samples.

74. NIKE-HERCULES Employment

a. NIKE-HERCULES battalions allocated to field army provide long-range air defense. In addition, the NIKE-HERCULES missile unit has a long-range, surface-to-surface mission capability. NIKE HERCULES battalions are normally assigned to ADA groups under the control of the ADA brigade at field army level.

b. NIKE-HERCULES batteries are positioned throughout the field army area. The basic considerations for the disposition of fire units are weighted coverage, defense in depth, and position requirements.

c. The position pattern will vary depending upon the number of fire units available, the size and shape of the field army area, and the terrain. In order to provide mutual support, cover dead areas, maintain a sufficient density of fires, and prevent gaps, batteries should be within eight-tenths effective horizontal missile range of each other. To avoid ground observation and the bulk

of enemy fires, the forward batteries should be positioned not closer than 27 kilometers from the FEBA. The pattern of units must be adjusted to minimize radar masking.

d. Step-by-step planning procedures are contained in appendix II.

75. HAWK Employment

a. HAWK battalions allocated to the field army provide medium- and low-altitude air defense. Enemy aircraft will attempt to penetrate the field army air defense by choosing a method of attack that will be exposed to the least amount of AD missile fire. The low-altitude method of attack makes radar detection difficult because of terrain masking, ground clutter, and masking by the curvature of the earth. Therefore, HAWK battalions normally are allocated by field army to the corps. However, HAWK units required to provide low-altitude air defense for priority rear areas and to obtain defense in depth are assigned to ADA groups under the control of ADA brigade at field army level.

b. Basic considerations for the disposition of fire units are early destruction along low-altitude routes of approach, defense in depth, and position requirements.

c. Attacking at low altitudes to avoid detection imposes limitations upon the enemy. He must attack along routes of approach that provide flat, low, cleared terrain. HAWK units are deployed well forward along routes of approach to obtain early destruction, but at a distance behind the FEBA that will provide some protection from enemy artillery fires. HAWK units normally are not deployed closer than 6 kilometers to the FEBA. When protecting priority targets within the field army area, the fire units can be located farther out along the routes of approach. Fire units positioned along a route of approach are separated at distances that permit mutual support and overlapping fires and increase the defense capability against multiple attacks. Access routes, suitable terrain to eliminate radar masking, and communications requirements are considered in the determination of HAWK battery locations.

d. Step-by-step planning procedures are contained in appendix II.

Section IV. OPERATIONS

76. General

Air defense operations are coordinated with other tactical support operations in the tactical operations centers established at

field army and corps. Tactical operations are conducted by the Army air defense command posts (AADCP) established in the field army and corps areas. The AADCP coordinates air defense operations with Army aviation Flight Operations Centers (FOC), Air Force Control and Reporting Centers (CRC), and Naval Tactical Air Control Centers (TACC).

77. Field Army Tactical Operations Center FATOC (fig. 21)

a. The FATOC is established by the field army commander to assist in the tactical operation aspects of his exercise of command. The FATOC is manned by representatives of the general and special staff sections concerned with tactical operations and tactical support. These representatives assist the commander by providing information on current tactical operations and the tactical support available, making recommendations for command decisions, taking action within established policies, and issuing implementing instructions.

b. Authority for the conduct of tactical operations and Army tactical support operations should be decentralized to subordinate commanders to the maximum extent practicable. Only the minimum control and coordination necessary for effective combat operations should be exercised over subordinates. Maximum use should be made of established policies and standing operating procedures (SOP).

c. Based on the above principles and the policies of the commander, the staff representation in the FATOC assists the commander in:

- (1) Direction, control, and coordination of current tactical and tactical support operations of his organic, assigned, or attached forces.
- (2) Integration of that support provided to him by other Army elements and by elements of the other service with the tactical and tactical support operations of his organic forces.
- (3) Coordination of operations with other services as authorized or agreed to by the separate commanders.

78. Air Defense Element (ADE), FATOC

a. General. The ADE represents the field army air defense officer who is responsible for providing personnel for its operation. It operates in the FATOC and performs the primary function of coordinating Army AD operations with other tactical support operations. The ADE coordinates the utilization of the airspace

of the utilization of airspace over the field army. He insures that other interested FATOC elements are kept informed on the status of AD means to include AD surface-to-surface capabilities.

79. ADE Functions and Operational Procedures

a. Supervises and coordinates Army AD operations.

- (1) Insures that current Army AD operations are conducted in compliance with SOP, the policies of the unified commander, or agreements in effect among the service component commanders or service element commanders.
- (2) Makes a continuing estimate of the air defense situation, and makes recommendations to the G3 element as appropriate.
- (3) Issues necessary instructions to AD units based on instructions from the G3 element, or as required by the AD situation, the tactical situation, or other tactical or tactical support operations.
- (4) To the maximum extent practicable, delegates detailed direction of AD operations to the AD units.

b. Coordinates Army AD operations with other tactical support operations.

- (1) Maintains accurate and timely display of the field army AD situation based on information received from the AD units.
- (2) Recommends redistribution and reallocation of means to insure proper use of AD means within established priorities.
- (3) Coordinates the establishment of procedures to insure the effectiveness of the AD system. All tactical and tactical support operations are monitored to minimize interference that limits the effectiveness of the AD system. Appropriate coordination and action with other FATOC elements is taken by the ADE on all matters in this category.
- (4) Directs the AD units to modify operations to the extent required in order that certain operations may be carried out to fulfill other tactical operational requirements.
- (5) Insures that AD ECM operations are coordinated with other EW operations being conducted. This coordination is effected between the ADE and the communications-electronics element (CEE).
- (6) Insures that the AD intelligence system is integrated with the other intelligence activities of the field army and

that it provides the maximum practicable assistance to the Army aviation units. Required coordination is accomplished with the G2 element and the Army aviation element (AAE).

c. Supervises and coordinates the use of nuclear weapons in AD operations.

- (1) Revises minimum heights of nuclear weapon bursts in light of the current tactical situation and in consonance with established rules of engagement and theater directives.
- (2) In coordination with AAE, tactical air support element (TASE), and fire support element (FSE), recommends safe areas for aircraft outside corridors as appropriate and in consonance with established rules of engagement.
- (3) Advises the FSE and the G3 element on the use of AD means for attack of surface targets.
- (4) Recommends to the G3 element the allocation or reallocation of nuclear weapons for AD units.

d. Coordinates Army AD operations with other services.

- (1) The ADE determines from the appropriate Air Force or Naval headquarters or agency the air defense capabilities and planned use of air defense means under the control of that service for air defense protection.
- (2) The chief of the ADE, in conjunction with the AD commander, coordinates with the representatives of the other services concerned to determine how the most effective air defense of the area can be accomplished with the air defense means available. Other service air defense capabilities may be integrated into an overall plan or may be furnished upon request from the ADE or the AD commander.
- (3) Upon reaching tentative agreement as to how the air defense capabilities of other services can best be integrated into the overall air defense effort, the chief of the ADE submits appropriate recommendations to the G3 element.
- (4) Upon command approval of the general use of air defense means, the AD commander establishes liaison with the other services concerned and performs the detailed coordination of the overall air defense operations.
- (5) Requests for air defense support from other services are referred to the ADE.

- (6) Conflicts between the ADE and other services are referred to the G3 element for resolution.
- (7) The ADE recommends to the G3 element changes in policies regarding the coordination of AD operations, as appropriate.
- (8) The ADE disseminates information on AD operations or changes thereto to FATOC elements, other sections of the headquarters, other commands, and other services that are affected.

e. Coordinates the use of the airspace over the field army by Army and other services (par. 80).

f. Provides statistical data and operational reports on AD operations.

- (1) Provides and directs reporting procedures for AD requiring a minimum of reports from subordinate units. The time, content, and scope of reports required are contained in the SOP.
- (2) Serves as an information center on all matters pertaining to AD.
- (3) Collects, collates, displays, and disseminates AD statistical data and technical information of operational interest.

80. Coordination of Airspace Utilization

(fig. 22)

a. General. The Army has primary responsibility for operations and conducts the major portion of activities in the CZ including the airspace above it. In the coordination of AD operations with other tactical support operations, one of the main functions of the ADE, FATOC is responsible for the coordination of the utilization of the airspace above the field army. Coordination must be effected if tactical support operations are to be successful.

b. ADE Airspace Utilization Planning.

- (1) *Coordination of the use of the airspace by Army forces.*
 - (a) Determines from the other FATOC elements (particularly AAE and FSE) their requirements for the use of the airspace over the field army area. Conflicting requirements that cannot be resolved among the affected elements are referred to the G3 element for resolution.
 - (b) In compliance with the commander's concept for use of the airspace by Army forces and in conjunction with the chiefs of the AAE and FSE, determines the manner in which all Army airspace requirements can be

met; submits appropriate recommendations to the G3 element.

- (c) Upon approval, the ADE prepares and disseminates implementing instructions to the user and traffic control agencies or units concerned.
 - (d) The ADE prepares and disseminates supplemental instructions as required by the tactical situation, tactical support operations, or as directed by the G3 element.
 - (e) Prepares such SOP's, policies, and directives as required to carry out the commander's concept for use of the airspace by Army forces; submits them to the G3 element for approval.
- (2) *Coordination of the use of the airspace over the field army area by other services.*
- (a) This coordination is effected to the extent authorized or directed by the unified commander or agreed to by the service component commanders or service element commanders concerned. It may be based upon prearranged procedures jointly agreed upon or approved by the appropriate joint force commander to minimize mutual interference among friendly forces. Examples of such procedures are the establishment of air corridors or routes of flight, airspace restricted areas, prescribed altitude under which Army aircraft will have freedom of movement within the air corridors, and rules of engagement. Minute-to-minute coordination based on such procedures can be decentralized to the designated field army AADCP, Army Flight Operations Centers (FOC), appropriate Air Force Control and Reporting Centers (CRC), and Naval Tactical Air Control Centers (TACC), which should be collocated in order to expedite this coordination.
 - (b) Information on the preplanned use of the airspace by other services may be disseminated by the ADE, with appropriate instructions, to other FATOC elements, other elements of the headquarters, and other commands that are affected.

c. AAE Airspace Utilization Coordination.

- (1) *Supervision and coordination of Army air traffic by AAE.*
- (a) Supervise the FOC in detailed air traffic planning and control.
 - (b) Determines from the ADE danger areas, restricted AD areas, and any other restrictions that have been imposed on air traffic by the commander, higher head-

quarters, theater, TJADC, or through agreements with other service components or elements.

- (c) Based upon these restrictions, disseminates aviation control restrictions; e.g., corridors, maximum and minimum altitudes, and areas in which all flights must be cleared, and supervises preparation of the Army air traffic control plan. Submits the plan to the G3 element for approval. Upon approval, disseminates the plan to affected FATOC elements, FOC, and Army aviation units as required.
 - (d) Reviews changes in air traffic instructions disseminated by the FOC to insure compliance with command policies and the air traffic control plan.
 - (e) Through liaison with other FATOC elements, determines those tactical and tactical support activities that will affect Army air traffic and disseminates changes to the Army air traffic control plan as required.
- (2) *Coordination of Army aviation requirements for use of the airspace by AAE.*
- (a) Provides information to the ADE on planned Army aviation operations to include flight planning data. This data includes, but is not limited to, points of origin, courses, destinations, altitudes, number of aircraft, and times of movements for integration in Army airspace utilization planning.
 - (b) Resolves conflicts with other users of the airspace directly among the users or refers them to the G3 element for resolution.
 - (c) AAE monitors Army aviation operations to insure compliance with the commander's concept on use of the airspace and with procedures agreed upon among the Army users of the airspace.
 - (d) Prepares and disseminates, as required, to the FOC and affected Army aviation units changes in procedures to be followed.

d. *G2 Air Group-Tactical Air Support Element (TASE)*. TASE is responsible for coordination of tactical air reconnaissance requests with the ADE.

- (1) Prior to approval of requests for tactical air reconnaissance to be flown by the TAF, the chief of the G2 air group contacts the ADE to insure that no conflicting requirement for the use of the airspace exists at the time and in the area the reconnaissance mission is to be flown. Detailed coordination of the TAF flight is effected between the CRC, AADCP, and FOC concerned.

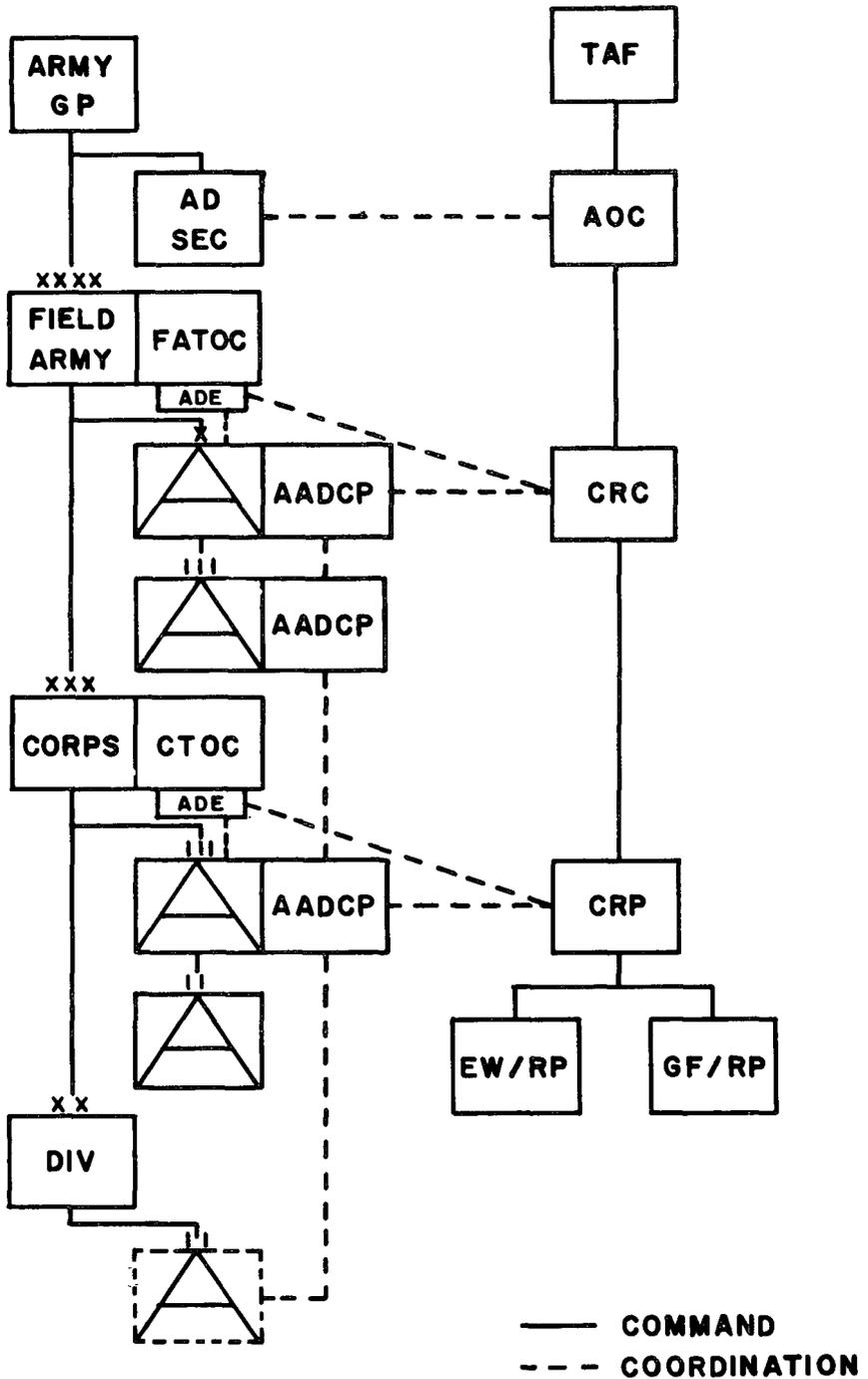


Figure 22. Coordination of airspace utilization (Army/Air Force).

- (2) Coordination for use of the airspace for reconnaissance missions being flown by Army aviation is accomplished by the AAE.

e. G3 Air Group-TASE. Requests for offensive air support are coordinated with the ADE. Prior to approval of requests for offensive air support to be flown by TAF, the chief of the G3 air group contacts the ADE to insure that there is no conflicting requirement for the use of the airspace at the time and in the area the mission is to be flown. Detailed coordination of the TAF flight is effected between the CRC, AADCP, and FOC concerned.

81. Coordination of AD Surface-to-Surface Capabilities

The nuclear surface-to-surface fire support missions by AD units are planned and coordinated by the fire support element (FSE) with the ADE.

a. Supervision and Coordination of Surface-to-Surface Fire Support Operations. The chief of the FSE supervises the preparation of the fire support annex to the operations order and reviews the component fire plans (artillery, air, naval gunfire, and the nuclear portions of each if prepared separately) to insure that all surface-to-surface and air-to-surface fires are integrated. He also coordinates with ADE on use of the airspace, with CBR element (CBRE) for coordination with the CBR plan, with engineer element (ENGRE) for coordination with the barrier plan, and with ADE for fires to be used to attack surface targets and submits the fire support plan to the G3 element for the integration of fire with maneuver.

b. Recommendation of the Allocation and Reallocation of Nuclear Weapons To Be Delivered by Army Surface-to-Surface Means. Based on the commander's concept of the operation, missions assigned to subordinate commands, and the command relationship established between the subordinate commands and the surface-to-surface fire support units, the chief of the FSE prepares a recommended allocation or reallocation of nuclear weapons. This recommendation is coordinated with the chief of the G2 element (known or potential targets in the zone of the command receiving the allocation), chief of the G3 air group (weapons to be delivered by tactical air), chief of ADE (Army air defense means to be used in a surface-to-surface role), chief of the ENGRE (use of atomic demolition munition (ADM)), and the G4 representative in the FATOC (feasibility of distributing the weapons to support the allocation or reallocation).

c. Recommendation of Targets To Be Attacked With Nuclear Weapons. Based upon target intelligence received from the G2

element, the FSE evaluates targets continuously as they develop. The FSE recommends to the G3 element those targets that should be attacked with nuclear weapons. These recommendations are coordinated with the G3 air group (targets to be attacked by tactical air), ADE (tentative airspace authorization), ENGRE (when use of ADM is recommended), and the CBRE (when significant fallout may result).

82. Procedures for AD Nuclear Weapons

a. General. The use of nuclear weapons has broad implications. The decision to initiate employment of nuclear weapons is beyond the authority of the military commander and will be made at the highest political level.

b. Allocation. Once the decision is made, the allocation of nuclear weapons to a commander at any echelon carries with it the authority to use them in combat. Their use will be prescribed in rigid SOP's established through theater of operations policies. The decision to employ AD units in the surface-to-surface role must be that of the commander exercising operational control over these units.

c. Control. Army AD nuclear weapons normally are issued to and placed under ADA missile battery control. The battery commander has the capability to fire a nuclear weapon whenever the conditions prescribed in the SOP's are met. Responsiveness to surface-to-air firing by the missile battery does not permit involved coordination procedures with a higher echelon. The responsibility for the use of AD nuclear weapons must lie with the commander having AD mission responsibility for the defended area. The authority to fire, in accordance with governing SOP's, must be delegated to the fire unit.

d. Fallout-Producing Nuclear Bursts.

- (1) *Command responsibility.* Authority to employ fallout-producing bursts will not be fixed at any echelon of command except as directed by the highest tactical commander in the area of operations. Normally, such authority will be delegated to the lowest commander whose area of operations can be expected to encompass the probable area of predicted tactically significant fallout. Commanders who have been delegated the authority to fire nuclear weapons must consider the tactical results from the use of radioactive fallout by deliberate near-surface, surface, or subsurface bursts. Commanders must predict, measure, and disseminate fallout contamination information to adjacent units and other ser-

vices operating in the area. Employment of radioactive fallout in a tactical role must be based on evaluation of the following factors :

- (a) Expected tactical advantage.
 - (b) Troop safety.
 - (c) Effect on adjacent command area of interest.
 - (d) Future use of the contaminated area.
 - (e) Restrictions imposed by higher authority.
- (2) *Staff responsibilities.* Prediction of fallout for employment in a tactical role is a normal part of target analysis under the staff supervision of the operations staff officer. At command echelons of division level and above, the chief of the chemical, biological, and radiological element (CBRE) of the tactical operations center (TOC) is responsible for predicting the tactical effects of fallout. He coordinates with the chief of the fire support element (FSE) and, based on the planned yield, height of burst, ground zero, and the best available meteorological data furnishes to the FSE the fallout prediction for incorporation into the target analysis.
- (3) *Area of employment.* Nuclear weapons will not be used in close proximity to the line of contact due to troop safety considerations and the inability to precisely predict fallout. However, depending on command guidance and target analysis as outlined in FM 101-31, the criteria for employment of nuclear weapons will vary.
- (4) *Delivery means.* All nuclear weapon delivery means which have a near-surface, surface, or subsurface burst capability can be used to produce radioactive fallout. Subsurface bursts produce areas of contamination that are more intense, though smaller in extent, than those produced by surface bursts.

83. Independent Corps Tactical Operations Center (ICTOC) (fig. 23)

The staff responsibilities and the functions of the ADE of an ICTOC are essentially the same as those described for the ADE of a FATOC. Modification of certain procedures is required because the ICTOC is one echelon closer to the conduct of operations and theater or task force coordinating procedures may vary. Coordination procedures with other services by field army will be effected similarly by the independent corps.

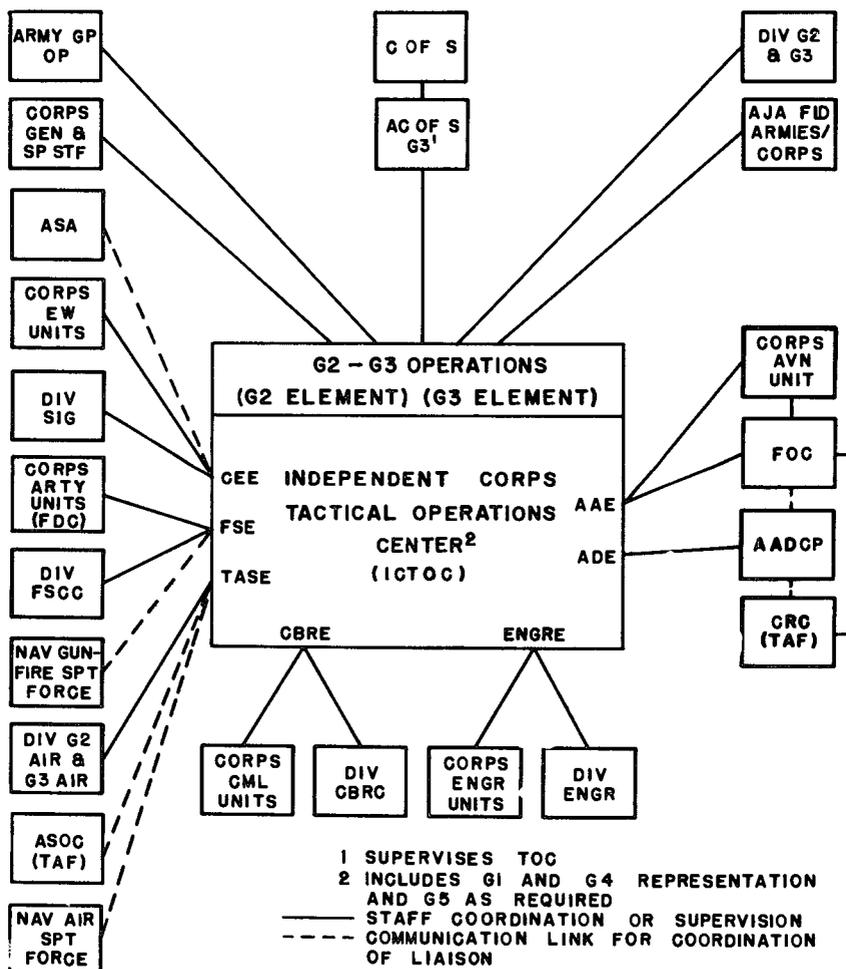


Figure 23. Data flow diagram, ICTOC.

84. Corps Tactical Operations Center (CTOC)

The staff responsibilities and the functions of the CTOC elements are essentially the same as those described for the FATOC and ICTOC. Direct coordination of AD policy matters by the ADE with the Air Force is not effected below independent corps level. Recommendations on AD coordination with other services are forwarded, after command approval, to the ADE, FATOC.

85. AADCP, ADA Brigade

a. The brigade AADCP is established as the tactical headquarters of the field army AD commander. The AADCP collects and evaluates information and disseminates AD intelligence to AD units with the field army. The brigade AADCP exercises command of field army AD units through the group AADCP's.

b. Secondary functions of the AADCP are to:

(1) Act as a center for AD liaison and coordination.

(2) Exchange AD information and intelligence with higher, lower, and adjacent agencies.

c. The AADCP is under the command of the ADA brigade commander. The duties of organizing and supervising its operation are normally delegated to the executive officer.

d. The brigade AADCP is located to facilitate the coordination and exchange of AD intelligence with interested agencies of the Army and other services. Siting considerations should include communications requirements and ADE operational requirements at the FATOC.

e. The ADA brigade commander will designate a group AADCP as an alternate brigade AADCP. The alternate AADCP will prepare necessary liaison, coordination, and communications plans to facilitate assuming the functions of the brigade AADCP in the event the brigade AADCP goes out of action.

f. For detailed capabilities, characteristics, and operations of the various types of AADCP and fire distribution system (FDS) equipment provided for AD operations see FM 44-8.

86. AADCP, ADA Group

a. The group AADCP is established as the tactical headquarters of the ADA group commander. The fire distribution system (FDS) AN/MSG-4 Missile Monitor is used in the field army to integrate the battalion fire distribution centers (BFDC) and ADA batteries with the group AADCP.

b. The group fire distribution center (GFDC) of the AADCP contains the facilities through which the group commander may exercise fire distribution, supervise fire unit operations, and exchange information with brigade, adjacent FDS's, TAF, and FOC.

87. Modes of Operation

a. The AD commander determines the mode of operation best suited to the particular defense situation. It is put into effect verbally and does not require system changes. AD unit procedures for each mode are established in detail in the AD SOP's.

b. In the *centralized* mode, target assignments are made directly from the GFDC or BFDC, depending on the method of operation in effect. Fire units are permitted to engage only designated targets. The defense effort is conducted by the AD commander through fire distribution and supervision of fire unit operations.

c. In the *decentralized* mode, the fire unit commander selects and engages targets in accordance with AD SOP's and the judicious use of furnished reference data. The GFDC or BFDC provides the most accurate information available and monitors fire unit actions.

d. A *combination* of the modes may be desired for the defense, or sectors of the defense may be designated different modes. With this flexibility, the AD commander may tailor the defense to cope with varying enemy actions.

88. Methods of Operation

Missile Monitor is capable of operating in six different switch-selected methods. Three of the methods are for use during tactical operations and are described below. The other three methods for use during installation after displacement and for emergency operations are described in FM 44-13.

a. The *normal* method of operation provides two-way ADL with all units in the system. The GFDC can send selected reference data and commands to, and receive tracking data from, all fire units. The BFDC enters local radar data into the system and monitors the action.

b. The *sector* method of operation provides two-way ADL with selected battalions of the defense and limited ADL with the others. In this method the AD commander retains supervision of the selected battalions. The other battalions receive reference data from the GFDC, but the battalion commander supervises his own fire unit operations through the BFDC.

c. The *independent* method of operation provides ADL between a battalion and its fire units but does not provide ADL with GFDC and other BFDC data. The battalion is the highest echelon in this system. The battalion commander supervises fire unit operations through the BFDC. In this method, means may be established for the BFDC to receive data from TAF.

89. Army Air Traffic Regulation and Identification (AATRI) System (fig. 24)

a. The field army commander is responsible for the regulation of Army air traffic over his area of responsibility. The AATRI

system is established to coordinate and expedite the safe and orderly flow of Army air traffic under all flight conditions, facilitate AD operations, and provide inflight assistance to Army aircraft.

b. The AATRI system must maintain liaison with the AD system. The Army aviation staff officer at each command echelon insures that such liaison is maintained.

c. Normally one flight operations center (FOC) and an alternate at reduced strength are assigned to each field army and corps. Flight coordination centers (FCC) are used to extend the FOC capability into high-density air traffic areas forward of the corps FOC's. FOC's, FCC's, position fixing navigation system (PFNS), and airfield control towers are the basic elements of the AATRI system.

d. FOC's and AADCP's are collocated at field army and corps to provide aircraft regulation, separation, and inflight assistance, and coordination of Army aviation with AD operations on a continuous basis. The FOC's assigned area of responsibility will approximately coincide with that of the AADCP. Coordination with Air Force Control and Reporting Centers (CRC) is maintained by AADCP's and FOC's.

90. Army Aircraft Traffic Regulations

Four general types of traffic regulations utilized by Army aviation in the CZ are *forward area regulation*, *route regulation*, *point-to-point regulation*, and *airfield control*. The field army area is divided into three subareas: *subarea 1* is forward of the FEBA to the maximum effective range of AD missiles; *subarea 2* is between the FEBA and the division rear boundary; and *subarea 3* is between the division rear boundary and the field army rear boundary (may extend into the COMMZ when necessary).

a. Forward area regulation is that area of Army air traffic regulation encompassed in subareas 1 and 2 of the field army area. The primary purpose of forward area air traffic regulation is to identify aircraft to AD units. These regulations may be modified by the force commander when required by the tactical situation.

- (1) Identification of friendly aircraft in the forward area is accomplished primarily by IFF and secondarily by the use of code names assigned to areas of operation. The latter system, designed for aircraft operations in subarea 2, may be extended into subarea 1 when operational requirements dictate.

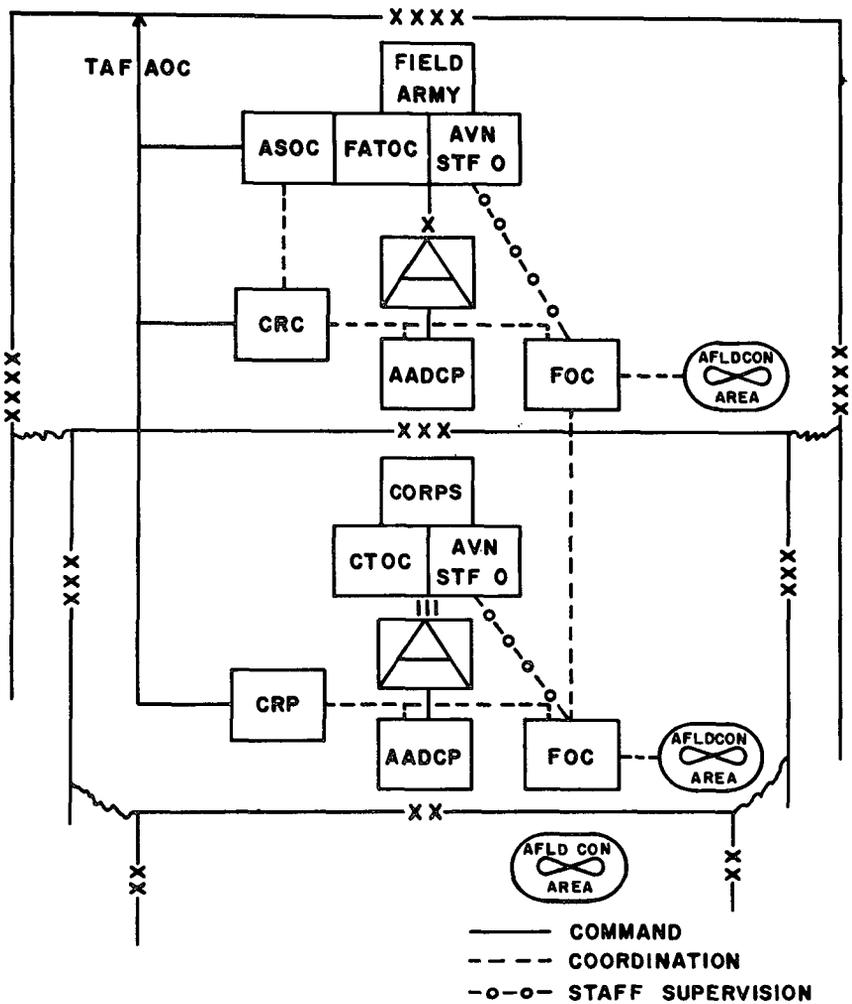


Figure 24. AATRI system, field army.

- (2) For concerted air movements in the forward area, pre-planning by commanders must include complete coordination with FOC and AD agencies to include forward AD units.
- (3) Flight plans will be transmitted to the appropriate FOC by Army aviators for flights originating in subarea

3 and operating in the forward area. The FOC, in turn, will forward pertinent information to the AADCP. The appropriate AADCP makes any position information on friendly aircraft available to the FOC in such a manner as to best facilitate air traffic regulation and identification.

- (4) Except when modified by tactical SOP, Army aviators operating aircraft within subarea 2 may file abbreviated flight plans with the appropriate base airfield having communications with FOC. The AD is thereby made aware of the friendly identification of the flight.
- (5) Except when modified by tactical SOP, Army aviators operating aircraft within subarea 1 will file a flight plan. Subarea 1 reconnaissance-type air operations, characterized by minimum altitudes to avoid radar detection and by diversity of movement and location to accomplish assigned missions, may require airborne radio relay facilities as an intermediary communications link. In this way, the reconnaissance information obtained is transmitted to the appropriate commander. This procedure informs FOC of the location and identity of the aircraft involved.

b. Route regulation regulates Army air traffic to the rear of division base airfields and may, during major air operations or when required by AD, regulate Army air traffic forward of division base airfields. Primary air routes are established by the field army commander. They consist of commonly traveled routes and are established between nondirectional beacons located at airfields of major echelons to include division base airfields. Special air routes may be established for short-time operation of large numbers of aircraft and for surveillance aircraft and drone flights from rear to forward areas. Secondary air routes, to supplement primary routes, may be established as required.

c. Point-to-point regulation pertains to Instrument Flight Rule (IFR) flights off air routes in subarea 3. Flight plans and position reports are required. AADCP may provide location reports to FOC on Army aircraft operating in the field army area outside established air routes. Regulation of these flights is the responsibility of FOC.

d. Airfield (control zone) control is established for each major Army airfield in the CZ. Control zones normally consist of a designated area surrounding the airfield and extending upward to a designated altitude. The airfields maintain radio control of air traffic within their zones.

91. Army Aircraft Identification

a. Measures used for the identification of Army aircraft in the combat zone are prescribed by theater commander. These identification measures are based on published Allied and joint communication procedures, current identification procedures, and the requirements of the AD situation in the theater. These measures are implemented by integration into the established AATRI system in the field army.

- (1) Such operations include the following actions:
 - (*a*) The FOC informs the AADCP of any flight outside air corridors (routes) at the time the flight is to begin.
 - (*b*) The AADCP monitors available plots until the flight in question is positively identified. Thereafter, it monitors the flight through all available means until it lands or reenters an air corridor.
 - (*c*) Should the identity of any flight appear in doubt, the FOC assists the AADCP in attempting to establish its identity. In doing so, it may recheck flight plans, communicate with other FOC's, establish radio communications with the flight in question, and order flight maneuvers as necessary to effect positive identification.
- (2) The density of aircraft operating outside air corridors (routes) normally will be greater in the division areas. AADCP concentrates on flights outside air corridors insuring continuous, positive identification. For friendly flights returning from hostile areas, the time, altitude, direction of flight, and place of reentry must be coordinated.

b. The primary means of identification of Army aircraft in the CZ is IFF. Other means of identification of Army aircraft are appearance, visual signals, general behavior, flight plan correlation, and the use of code names assigned to areas of operation. Air routes will habitually be used in rear areas to canalize friendly air traffic and facilitate identification. The FOC will accomplish recognition of aircraft by radio as a corollary to flight plans when challenging an otherwise unknown aircraft or as a part of emergency procedures.

92. AADCP-FOC Procedures

a. On receipt of a flight plan at FOC, the flight plan is recorded and pertinent information passed to the AADCP. Information furnished will include—

- (1) Number of aircraft in flight.
- (2) Route or track to be flown.
- (3) Departure time.
- (4) Estimated time en route.
- (5) Estimated time of flight termination.
- (6) Altitude.

b. The FOC will notify the AADCP of termination of flights and changes in flight plans.

c. The AADCP is notified of all Army aircraft operations in the area, and upon request the FOC will verify or identify flights in progress.

d. If hostile flights are discovered in the same areas as friendly IFR traffic, the FOC will transmit an immediate change of flight orders to isolate the enemy aircraft for AD action. When hostile air activity reports are received from Army aircraft, the FOC will immediately notify the AADCP.

e. The FOC provides emergency inflight assistance to Army aircraft. The FOC may request the AADCP to provide aircraft position data. The FOC will notify the AADCP of emergency action taken and provide new flight data.

f. The FOC displaces with the AADCP. During the displacement, the AATRI responsibility will be assumed by an alternate FOC or by one of the other AADCP-FOC teams within the area.

93. AD Reports

The field army AD commander controls the preparation and publication of AD reports and their consolidation into statistical data of operations. The preparation of AD reports is prescribed by the field army AD commander in the AD SOP. Sample forms of AD reports are presented in appendix IV.

Section V. DISPLACEMENT OF AIR DEFENSE UNITS

94. General

The purpose of reconnaissance, selection, preparation, and occupation of position is to move an AD unit from a firing position, bivouac area, rendezvous, or march column into a firing position from which the unit is able to accomplish its mission. Methods of executing the move vary with the mission, type of unit, the time available. When the battalion commander or staff does not select positions on the ground, the battery commander may be assisted by the staff. An AD unit generally will have sufficient time to

execute a *deliberate* move; however, the same considerations apply to a *hasty* move.

95. Reconnaissance

The two general classes of reconnaissance are position and route. Usually, position and route reconnaissance are accomplished simultaneously; however, either may be accomplished separately. Position reconnaissance is made for the purpose of selecting actual positions for the location of the major items of equipment. Route reconnaissance is made for the purpose of selecting suitable routes to and from a selected position.

96. Types of Reconnaissance

The three types of reconnaissance are map, aerial, and ground.

a. Map reconnaissance precedes ground or aerial reconnaissance and is used as the basis for planning. Map reconnaissance is generally accomplished by higher headquarters to give the unit the maximum time in which to accomplish more detailed reconnaissance. Map reconnaissance allows the coverage of a large area in a short period of time.

b. Aerial reconnaissance is often used preceding a ground reconnaissance. Aerial reconnaissance allows a large area to be reconnoitered in a short period of time and reflects accurate and current information.

c. Ground reconnaissance is the most important of the three types. It should always be made at the lower echelons. Ground reconnaissance verifies terrain suitability as pertains to routes and positions and offers accurate, current information.

97. Reconnaissance Planning

The planning of any reconnaissance usually starts with a map reconnaissance. Based upon this map reconnaissance, the commander decides the area to be reconnoitered and what information is desired. The commander decides the number of vehicles and personnel to comprise the party and accomplish the reconnaissance properly. Prior to beginning the reconnaissance, the commander should brief his party on the tactical situation and march details. When time is limited, it may be necessary to decentralize the reconnaissance. A time and place should be established where the members of the party are to assemble upon the completion of their respective reconnaissance.

98. Position Selection

The primary consideration in position selection is the accom-

plishment of the tactical mission. The reconnaissance provides the information necessary to select the position that enables the unit to accomplish its mission and also satisfy weapon system requirements.

99. Position Requirements

Positions selected for AD units must meet weapon system requirements and safety distances. Radar locations must meet coverage and cable limitation criteria. The terrain should be generally level, firm, and have adequate drainage. Selected positions must be readily accessible and large enough to accommodate all of the installations necessary for proper functioning of the unit. Dispersion and control requirements should be considered. Protection for personnel and appropriate equipment by digging in below ground level is desirable. Fields of fire and observation for local security are planned during position selection.

100. NIKE-HERCULES Position Requirements

The NIKE-HERCULES missile battery requires specific considerations during the selection and preparation of position. Principles of reconnaissance, selection, preparation, and occupation of position as applied to NIKE-HERCULES batteries are—

- a.* Area requirements.
- b.* Radar suitability.
- c.* Relation of launching area to battery control area.
- d.* Line-of-sight requirements.
- e.* Separation distance.
- f.* Cable limitations.
- g.* Safety distances.
- h.* Assembly and service area requirements (when performed at battery level).
- i.* Storage area requirements.
- j.* Booster impact area.

101. HAWK Position Requirements

In selecting a battery position for HAWK, the following criteria must be considered:

- a.* Area requirements.
- b.* Maximum line-of-sight for radars.
- c.* Maximum emplacement slope for radars and launchers.
- d.* Access routes.
- e.* Camouflage.

102. Position Preparation

The position selected may require preparation before it can be occupied by the unit and used effectively. The preparation is planned and supervised to insure that equipment vital to the unit's operation is installed first. The defense cannot be degraded by allowing the unit to remain out of action for long periods of time while preparations are performed. Preparation time must also be considered in planning the actual move and occupation time. Some of the position preparation actions that may be required are—

- a.* Constructing or improving access routes.
- b.* Removing obstacles or mines.
- c.* Clearing areas to improve radar coverage.
- d.* Clearing areas to satisfy line-of-sight requirements.
- e.* Preparing locations for major pieces of equipment.
- f.* Excavating.
- g.* Installing communications facilities.

103. Occupation of Position

a. Prior to moving into position, the occupation is planned in detail. The exact location and the sequence for establishing each installation is determined. The position should be occupied with the least amount of delay and confusion. Occupation should be progressive with installations most vital to the accomplishment of the mission established first.

b. During occupation of position the following priorities exist although they normally are accomplished simultaneously:

- (1) Prepare to fire.
- (2) Install communications.
- (3) Establish local security.

c. Improvement of position should be continuous.

104. Movement of Units

a. Changes in the field army boundaries may indicate that the AD deployment can be improved by moving units. The most desirable technique is to move a unit from a remote portion of the defended area into the new area. This leapfrogging technique minimizes the number of units required to move and maintains the maximum AD support during a move. Long moves may require the detachment of a battery from one battalion and attachment to another in the new area. The receiving battalion assists the battery in reconnaissance, selection, preparation, and occupa-

tion of position. Moves are coordinated at field army level to insure that sufficient AD support is maintained.

b. The long-range capability of NIKE-HERCULES missile units tends to reduce the requirement for frequent moves. Normally one battery is moved at a time. When limited transportation precludes moving as a unit, some of the launchers may be moved to the new position and emplaced. The remainder of the battery is then displaced as rapidly as possible.

c. HAWK units can move rapidly by motor or air transport. The time and frequency of movement is minimized by moving one battery at a time, either as a unit or by echelon. The HAWK battery can remain in action with one firing section while moving the other, thereby providing continuous, although limited, AD support.

105. Tactical Motor Movements

a. The frequency and long distances of moves and the large number of vehicles in AD units require extensive motor movement planning. The commander is responsible for tactical motor movements. The S3, working in close conjunction with the S4, has staff responsibility for considering all factors affecting a move. The S3 issues warning orders and recommends organization for the march, type of march column, control measures, and security measures. Based upon the commander's decision, the S3 makes necessary march computations, prepares march orders, and supervises the conduct of the march.

b. Security measures during the march should include advance, flank, and rear elements to detect enemy guerrilla forces and provide warning to the main column. Should an ambush occur, forceful action against the enemy guerrilla force's main effort is necessary. The exits from the ambush areas are normally blocked, mined, or covered by automatic weapon fire and must be cleared. Information of enemy guerrilla action is reported to the main body of the march column and subsequently reported to the appropriate area security control agency.

Section VI. COMMUNICATIONS

106. General

In the field army, the connecting facilities between air defense units will be provided by organic communications equipment and the field army area communications system. This system will furnish the facilities required to provide the automatic data link network and voice communications connections needed for an efficient air defense fire distribution system. Emergency backup for all

tactical communications is provided by predesignated preemptive channels through alternate routes of the area system. In the event of failure in the normal routing, the predesignated alternate channel will be preempted immediately with minimum loss in communications.

107. Responsibility

a. The commander of each AD echelon is responsible for the installation, operation, and maintenance of the signal communications equipment issued to the elements of his command. Those commanders relying on communications facilities provided by other agencies are responsible for the proper and efficient use of those facilities by their command. The signal or communications officer of each unit, down to and including battalion, exercises immediate supervision over the installation, operation, and maintenance of the unit's communications agencies. He is also responsible for advising the commander on the employment of all communications facilities available to the unit.

b. To insure coordination, the commander of each tactical unit exercises both tactical and technical control over communications agencies of subordinate units. Tactical control insures the establishment of necessary communications between units in accordance with the tactical plan. Technical control standardizes the installation, operation, and maintenance of the various means of communications. To expedite technical control, the communications officer deals directly with the communications officers of subordinate units.

c. When an AD unit is protecting a unit or installation, it establishes liaison and communications with the unit it is supporting.

108. Planning

Communications planning is a continuous operation beginning with the commander's estimate of the situation and continuing through to the next operation. Communications planning is conducted concurrently with operational planning and in coordination with other staff officers. Communications planning follows the normal phases of headquarters planning prescribed in FM 101-5. An initial estimate of the communications requirements is made to implement the operation plan of the commander.

109. Communications Nets

a. *Command and Administrative Net.* Two-way communications. Used for transmission of command, administrative, and logistical information.

b. Air Force Early Warning Net. One-way communications. Used for transmission of plots of airborne objects from Air Force sources.

c. Air Force Liaison Net. Two-way communications. Used for exchange of information between the AADCP and an Air Force installation.

d. Other Liaison Nets. Two-way communications. Used for exchange of information between the AADCP and other units such as adjacent AADCP's and the Navy.

e. Radar Reporting Net. Two-way communications. Radar plots from defense acquisition radars are transmitted directly to the AADCP.

f. OP Reporting Net. Two-way communications. If visual air defense OP's are established, the AADCP should monitor this net between the OP and its parent unit.

g. Intelligence Net. One-way communications. Used for the transmission of urgent and significant tactical information from the AADCP to fire units. Information transmitted includes the location and identity of airborne objects, states of alert, and similar information.

CHAPTER 10

AIR DEFENSE IN SPECIAL OPERATIONS

Section I. SPECIAL OPERATIONS

110. General

a. Special operations are those in which the terrain, weather, or nature of the operation, or a combination of these influences, creates the need for special techniques, tactics, or equipment.

b. The fundamental principles for the employment of AD involved in these special operations are, in general, the same as for any normal type of operation; however, the tactics and techniques by which those principles are applied may be modified. The problems and differences that arise from those special operations are mainly in training, movement, and logistics. Details on special operations will be found in the manual pertinent to that type of operation.

111. Liaison

a. Liaison assumes major importance in special operations. Normal command and staff liaison is established and maintained. Liaison officers are employed between major elements involved in the operation. Normal liaison between echelons within each element is expanded. Liaison must be established early and maintained continuously to insure smooth and efficient progress from one phase of planning and preparation to the next. Exchange of information and coordination of plans are necessary to assure the commander that AD means are used to the maximum advantage and that, in the case of joint operations, provision is made for smooth transitions of responsibility for air defense coordination from one force to another.

b. Liaison requirements during the preparation for, and conduct of, special operations of a joint nature may necessitate assigning this function as an additional duty to staff members and lower echelon commanders. This procedure, although placing a greater burden on designated staff members and commanders, is desirable because those involved in interservice liaison and coordination are also directly involved in planning for their respective units.

Section II. AMPHIBIOUS OPERATIONS

112. General

a. The complex nature of amphibious operations make detailed planning extremely important. An outstanding difference between amphibious operations and other operations is the ship-to-shore movement. Centralized supervision by AD commanders and staffs is lost from the time of embarkation aboard ship until reorganization ashore. During this interval, which may extend for several weeks, the actions of units embarked separately may often be governed exclusively by written orders.

b. Because shipping requirements frequently disrupt the unity of organizations, it is necessary that combat orders be written in much more detail than orders for other types of operations. Considerations for planning that are unique in amphibious operations are discussed in the following paragraphs. For further details on amphibious operations see FM 31-12.

113. Air Defense Plan

a. *Organization for Combat.* The principles of organization for combat that apply to normal land operations are applicable to amphibious operations. Where combat elements are to land at widely dispersed beaches, it may be necessary to attach some AD FAW to assault elements until portable missiles reach the hands of troops. Other AD units should be given the mission of establishing an integrated air defense of the landing force as a whole. Initially, AD FAW have the mission of moving with and protecting specific elements of the landing force from air attack with little or no regard for the integrated air defense plan. At the earliest practical time, the AD FAW will be integrated into the overall air defense structure.

b. *Organization for Embarkation.* Each AD FAW normally will be assigned the mission of defending a specific element of the landing force and will embark at the same time as the element that it is to defend. Other AD should normally be organized for embarkation as a separate embarkation group. The following personnel are usually embarked as indicated:

- (1) Air defense commanders and AADCP personnel with their respective supported unit commanders.
- (2) Liaison parties with the units with which they are to maintain liaison.
- (3) The remainder of the AD units so as to maintain as much of the tactical unity of the organization as possible.

c. *Control and Coordination.* The general concepts of control and coordination apply to AD in amphibious operations; however, several specific considerations are introduced.

- (1) During the early stages of the landing, the required air defense will be provided predominantly by Navy ship-borne surface-to-air guided missiles and guns and fighter aircraft of Naval and Air Forces. Air defense operations will be controlled by the Navy. Control and coordination of all AD fires during this period must be compatible with the Navy anti-air-warfare plan and must permit effective utilization of all AD firepower.
- (2) The lack of adequate Army AD communications facilities during these early stages may further complicate control and coordination procedures. Rules for identification and recognition and rules of engagement must be carefully planned and disseminated prior to the landing to insure maximum effectiveness of air defense and prevent unnecessary interference with friendly aircraft. Such rules must facilitate effective air defense with a minimum of communications.
- (3) When the Army landing force is established ashore, with adequate communications and control facilities, the Army landing force commander assumes control of tactical land operation, shore party activities, and tactical support operations at his command post ashore. This assumption of control includes those air defense forces supporting the land operations. This transfer of air defense control must be carefully coordinated to insure maximum effectiveness of air defense during the transfer.

114. Rehearsal

Because of the many details involved, it is desirable that the plans for an amphibious operation be tested by rehearsal to insure that all units are familiar with the embarkation and debarkation procedures and techniques. A rehearsal of communications procedures and assault timing should be held.

115. Movement to the Beach

In an amphibious operation, certain elements of an AD unit must land prior to their AD weapons. These elements include liaison personnel and reconnaissance parties. A planned sequence of landing is essential to an orderly and well-controlled landing. The sequence of landing for a ship-to-shore movement complete with all elements is given below.

a. AD liaison parties land with the command post of that element of the landing force that their respective units are to support. Liaison officers keep their AD headquarters informed as to suitable landing beaches, exits from the beach, the condition of position areas, and the progress of elements ashore.

b. The AD reconnaissance parties are landed as early as the situation ashore permits to reconnoiter the tentative position areas and select final positions for the necessary installations. Being mindful of the time and space factors involved and the situation ashore, the reconnaissance party commander will recommend to the appropriate headquarters the position areas and the time to debark the remainder of the unit.

c. After the reconnaissance has been completed and when the beach areas are reasonably free from enemy fire, the AD unit supporting a specific element is landed on request of the reconnaissance party commander. The remainder of the unloading activities are a ferrying operation of ammunition, other supplies, and remaining personnel and equipment from the ships to the position areas.

d. Reconnaissance parties of ADA group and brigade headquarters batteries are landed at about the same time as those of their subordinate battalions. The remainder of these batteries are landed on the request of the reconnaissance party commander.

e. The landing force air defense commander and Army air defense command post personnel move ashore with the landing force commander. Army air defense command post personnel usually displace ashore in two echelons; the second echelon displaces after the first is in operation ashore in order to maintain continuity of communications and control.

APPENDIX I

REFERENCES

Department of the Army pamphlets of the 310-series should be consulted for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

AR 220-50	Regiments—General Provisions
AR 220-60	Battalions, Battle Groups, Squadrons—General Provisions
AR 220-70	Companies—General Provisions
AR 320-5	Dictionary of United States Army Terms
AR 320-50	Authorized Abbreviations and Brevity Codes
AR 380-series	Military Security
AR 525-30	Army Missiles
FM 1-5	Army Aviation; Organizations and Employment
FM 1-60	Army Aviation Air Traffic Operations—Tactical
FM 1-100	Army Aviation
FM 3-5	Chemical, Biological, and Radiological (CBR) Operations
FM 5-15	Field Fortifications
FM 5-20	Camouflage, Basic Principles and Field Camouflage
FM 5-36	Route Reconnaissance and Classification
FM 6-20-1	Field Artillery Tactics
FM 6-20-2	Field Artillery Techniques
FM 6-40	Field Artillery Cannon Gunnery
FM 7-11	Rifle Company, Infantry, Airborne Infantry, and Mechanized Infantry.
FM 7-20	Infantry, Airborne Infantry, and Mechanized Infantry Battalions
FM 7-30	Infantry, Airborne and Mechanized Division Brigades
FM 9-1	Ordnance Service in the Field
FM 21-5	Military Training
FM 21-6	Techniques of Military Instruction
FM 21-30	Military Symbols
FM 24-18	Field Radio Techniques
FM 24-20	Field Wire and Field Cable Techniques

FM 25-10	Motor Transportation— Operations
FM 30-5	Combat Intelligence
FM 31-12	Army Forces in Amphibious Operations (The Army Landing Force)
FM 31-15	Operations Against Irregular Forces
FM 31-25	Desert Operations
FM 31-30	Jungle Operations
FM 31-60	River-Crossing Operations
FM 31-70	Basic Cold Weather Manual
FM 31-71	Northern Operations
FM 31-72	Mountain Operations
(S)FM 44-1A	U.S. Army Air Defense Employment (U)
FM 44-2	Light Antiaircraft Artillery (Automatic Weapons)
FM 44-3	Light Antiaircraft Artillery (Skysweeper)
FM 44-4	Medium and Heavy Antiaircraft Artillery
FM 44-7	Electronic Search Central AN/GSS-1 and Radar Sets AN/TPS-1D, 1G, and AN/FPS-36
FM 44-8	Army Air Defense Command Posts and Army Air Defense Information Service
(C)FM 44-10	U.S. Army Air Defense Fire Distribution System, AN/FSG-1 (Missile Master) (U)
(C)FM 44-13	U.S. Army Air Defense Fire Direction System, AN/MSG-4 (Missile Monitor) (U)
(C)FM 44-14	U.S. Army Air Defense Fire Direction Systems, AN/GSG-5(V) and AN/GSG-6() (U)
FM 44-19	Qualification Program, Air Defense Artillery Weapons System
FM 44-22	Qualification Program, Air Defense Artillery Weapons System: NIKE-HERCULES and NIKE-AJAX
FM 44-23	Qualification Program, Air Defense Artillery Weapon System (HAWK)
FM 44-85	Air Defense Artillery Missile Battalion— NIKE-AJAX
(C)FM 44-95	Air Defense Artillery Missile Battalion, NIKE-HERCULES (U)
(S)FM 44-95A	Air Defense Artillery Missile Battalion, NIKE-HERCULES (U)
(C)FM 44-96	Air Defense Artillery Missile Battery, HAWK (U)

FM 44-97	Air Defense Artillery Missile Battalion, HAWK
(S)FM 44-97A	Air Defense Artillery Missile Battalion, HAWK (U)
FM 57-10	Army Forces in Joint Airborne Operations
FM 57-35	Airmobile Operations
FM 100-5	Field Service Regulations—Operations
FM 100-10	Field Service Regulations—Administration
FM 100-11	Signal Communications Doctrine
FM 101-1	The G1 Manual
FM 101-5	Staff Officers' Field Manual: Staff Organiza- tion and Procedure
FM 101-10, Part I	Staff Officers' Field Manual; Organizational, Technical and Logistical Data
(S)FM 101-31	Staff Officers' Field Manual; Nuclear Weap- ons Employment (U)
(S)FM 101-31 Modified	Staff Officers' Field Manual; Nuclear Weap- ons Employment (U)
DA Pam 108-1	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings
DA PAM 310- series	Military Publications Indexes
(CMHA)TM 11- 750	Radar Electronic Counter-Countermeasures for the Operator (U)

APPENDIX II

ESTABLISHMENT OF A MISSILE DEFENSE

Section I. INTRODUCTION

1. General

The fundamental principles in establishing a missile defense are—deny penetration and match the defense to the threat and to the vital area. The establishing of a missile defense is divided into planning, designing, and evaluating phases. The fundamental principles are adhered to by incorporating defense planning considerations, basic employment considerations, and weapon system considerations into these phases.

2. Planning, Designing, and Evaluating Phases

a. The planning phase determines the defense planning considerations for that particular defense. The defense planning considerations include attack assumptions, defense characteristics, and command specifications.

b. The designing phase consists of selecting basic employment considerations applicable to the particular weapon systems being employed. These selected employment considerations are then used in conjunction with the defense planning considerations to design the defense. The basic employment considerations and the weapon system considerations are listed in chapter 4.

c. The evaluating phase consists of an analysis of the defense design to determine if it is satisfactory or unsatisfactory. The defense design is unsatisfactory if it does not meet the command specifications determined during the planning phase or the basic employment considerations selected during the designing phase. The defense then must be redesigned to meet these considerations. If the allocation of means proves inadequate to attain a satisfactory defense, the command specifications must be altered or additional means must be provided.

Section II. THE PLANNING PHASE

3. Basic Considerations

The planning phase is based upon the attack assumptions, defense characteristics, and command specifications pertaining to

the particular defense. Attack assumptions include the estimated number of airborne objects available to the enemy for simultaneous attack, mass attack capabilities from one direction, multiple attack capabilities, and attack speed and altitude capabilities. The defense characteristics include single-shot kill probability (SSKP), operational reliability (OR), radar discrimination, system dead time for each specific system, and missile maximum effective altitude and horizontal range. The command specifications designate the area to be defended, maximum acceptable damage, kill assurance required, and maximum allocation of Army AD units. These planning considerations are explained in chapter 4. Missile system characteristics are contained in appendix, FM 44-1A.

4. Planning Phase Procedures

a. The first step is to define the vital area (VA) on a map or on an overlay, taking into account the effect of nuclear weapons that the enemy will attempt to deliver. The area containing the vital installations to be defended must be expanded by a buffer distance related to the effective damage radius of the enemy nuclear weapon capability, and the degree of damage that the area may suffer without endangering survival or ability to continue operations effectively. In the case of vital complexes in CONUS, this analysis is in the form of isodamage contours for all major population centers. For an installation or complex not analyzed, the same series of isodamage contours could be determined by applying appropriate damage templates to the areas and using varying degrees of destruction as contour bases. The yield of the enemy weapon must be estimated. The level of protection is designated by higher authority. The area encompassed by the selected isodamage contour of maximum acceptable damage to industry and population becomes the VA. This is the area that must not be damaged beyond the degree specified.

b. The second step (considering the threat as a manned bomber) is to inscribe the bomb release line (BRL) around the VA. The horizontal distance that a bomb will fall, forward from the release point to detonation just above the surface, is dependent principally on the speed and altitude of the releasing aircraft and can be determined from the bomb release distance graph (gravity) (fig. 25). Where low-altitude bombing system (LABS) techniques may be employed, the bomb release distance can be determined from the release technique and aircraft altitude and speed capabilities. The technique for drawing the BRL is to use a compass adjusted to the BRL distance. Place the point of the compass on several points along the edge of the VA and mark a series of arcs at a

radial distance from this edge. The BRL is then traced through the outermost points of the arcs. The BRL is the critical line beyond which the defense must be able to destroy all enemy aircraft and accomplish its mission by denying enemy penetration.

c. The next step is to determine the number of fire units required to effect denial of penetration. The attack assumptions, defense characteristics, and command specifications are the parameters for this determination.

- (1) Determine from table I the number of missiles (m) required to be expended against each target. Enter the specified kill assurance bracket and the SSKP column for the particular weapon system (app. FM 44-1A). The intersection of these within the table indicates the number of missiles required per target.

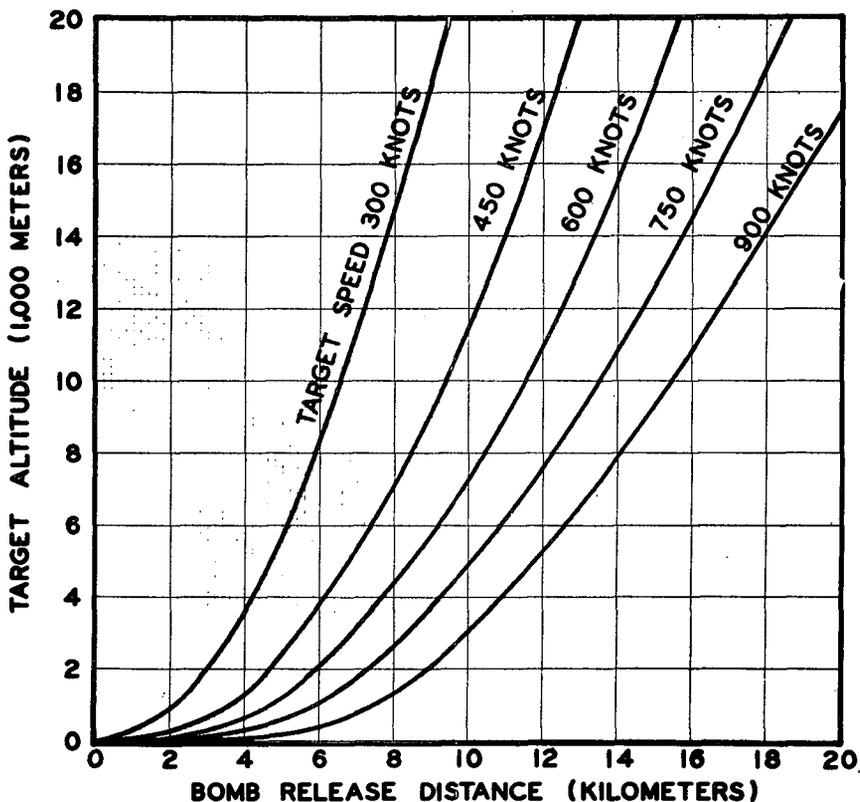


Figure 25. Bomb release distance graph (gravity).

NUMBER OF MISSILES REQUIRED PER TARGET

		SSKP								
		0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	0.99
KILL ASSURANCE	.99	4	4	4	3	3	3	2	2	1
	.98	4	4	4	3	3	3	2	2	1
	.97	4	4	3	3	3	2	2	2	1
	.96	4	3	3	3	2	2	2	2	1
	.95	4	3	3	3	2	2	2	1	1
	.94	3	3	3	3	2	2	2	1	1
	.93	3	3	3	2	2	2	2	1	1
	.92	3	3	3	2	2	2	2	1	1
	.91	3	3	2	2	2	2	2	1	1
	.90	3	3	2	2	2	2	1	1	1
	.89	3	3	2	2	2	2	1	1	1
	.88	3	2	2	2	2	2	1	1	1
	.87	3	2	2	2	2	2	1	1	1
	.86	3	2	2	2	2	2	1	1	1
	.85	3	2	2	2	2	1	1	1	1
	.80	2	2	2	2	1	1	1	1	1
	.75	2	2	2	1	1	1	1	1	1
	.70	2	2	1	1	1	1	1	1	1
.60	1	1	1	1	1	1	1	1	1	
.50	1	1	1	1	1	1	1	1	1	

(2) The number of missiles (m) required to obtain the desired assurance of killing one target must be modified by the OR factor and the number of simultaneously attacking airborne objects. The OR factor consists of two parts. The reliability portion varies with the design reliability of the particular missile system and the operational portion will vary with prevailing climatic conditions that may affect the reliability of the system, past operational records, technical support, crew proficiency, and maintenance schedules. The adjustment made to compensate for these degradational but realistic operational conditions is an estimated percentage. Training

and maintenance improvement and equipment modifications would cause these conditions to vary and the OR factor should then be adjusted. Solve the formula to determine the number of missiles required to be expended to obtain the desired assurance of killing the threat:

$$M_i = \frac{m \times n}{OR}, \text{ wherein:}$$

M_i = Number of missiles required to obtain the desired assurance of killing the threat

m = Number of missiles required to obtain the desired assurance of killing one target

n = Number of simultaneously attacking targets

OR = Operation reliability

- (3) Determine the average radius of the area within the BRL (measure the ground perimeter of the BRL and divide by 6.28 (2 pi)).
- (4) Enter the appropriate planning table (table I, II, or III, app. FM 44-1A) at the bracket inclosing the computed average radius of the BRL. Read across to the column containing the number of bursts equal to the computed M_i . The number of fire units required to design an adequate defense is indicated at the top of the column. *This is a planning figure only.* Because of normal siting limitations and terrain difficulties that generally preclude siting batteries at optimum locations, the determination of how many units are required will not be final until an evaluation of the defense is made. Use of measurement conversion tables (tables II and III) may be required for this and subsequent steps.

Table II. Conversion Table—Linear Measurements

Multiply number of By To obtain	Centi- meters	Meters	Kilo- meters	Inches	Feet	Yards	Nautical miles	Statute miles
Centimeters		10 ²	10 ⁵	2.540	30.48	91.44	1.853 x10 ⁵	1.609 x10 ⁵
Meters	0.01		10 ³	2.540 x10 ⁻²	0.3048	0.9144	1853	1609
Kilometers	10 ⁻⁵	0.001		2.540 x10 ⁻⁵	3.048 x10 ⁻⁴	9.144 x10 ⁻⁴	1.853	1.609
Inches	0.3937	39.37	3.937 x10 ⁴		12	36	7.296 x10 ⁴	6.336 x10 ⁴
Feet	3.281 x10 ⁻²	3.281	3281	8.333 x10 ⁻²		3	6080.27	5280
Yards	1.094 x10 ⁻²	1.094	1094	2.778 x10 ⁻²	0.3333		2027	1760
Nautical miles	5.396 x10 ⁻⁶	5.396 x10 ⁻⁴	0.5396	1.3703 x10 ⁻⁵	1.645 x10 ⁻⁴	4.934 x10 ⁻⁴		0.8684
Statute miles	6.214 x10 ⁻⁶	6.214 x10 ⁻⁴	0.6214	1.578 x10 ⁻⁵	1.984 x10 ⁻⁴	5.682 x10 ⁻⁴	1.1516	

Table III. Conversion Table—Linear Velocity Measurements

Multiply number of By To obtain	Meters per second	Feet per second	Yards per second	Miles per second	Miles per minute	Miles per hour	Kilo- meters per hour	Knots
Meters per second		0.3048	0.9144	1609	26.82	0.4470	0.2778	0.5148
Feet per second	3.281		3	5280	88	1.467	0.9113	1.689
Yards per second	1.094	0.3333		1760	29.33	0.4889	0.3089	0.5631
Miles per second	6.214 x10 ⁻⁴	1.894 x10 ⁻⁴	5.682 x10 ⁻⁴		1.667 x10 ⁻²	2.778 x10 ⁻⁴	1.726 x10 ⁻⁴	3.199 x10 ⁻⁴
Miles per minute	3.728 x10 ⁻²	1.136 x10 ⁻²	3.409 x10 ⁻²	60		1.667 x10 ⁻²	1.036 x10 ⁻²	1.919 x10 ⁻²
Miles per hour	2.237	0.6818	2.045	3600	60		0.6214	1.152
Kilometers per hour	3.6	1.097	3.291	5793	96.54	1.609		1.853
Knots	1.943	0.5921	1.776	3126	52.10	0.8684	0.5396	

5. Designing Phase Procedures

a. The first step in the designing phase is to determine where the fire units can best be situated to combat mass attacks from a single direction and at the same time maintain the most effective capability against multiple directions of attacks. This can be accomplished through defense in depth. The defense in depth pattern places some units well out from the VA and others close in. Firepower against a massed attack from one direction is increased by moving inward to a certain point. The multiple attack using large numbers of attacking aircraft and infiltration tactics to gain maximum surprise may also be employed. Effectiveness of defenses against multiple attacks is increased by choosing positions well out from the center of the VA. Earlier destruction and more time for attack also result from the choice of a pattern that places individual units well out from the VA. The decision as to where the fire units are to be located must be a compromise between moving inward to maximize firepower against a massed attack and moving outward to increase early destruction and effectiveness against multiple attacks. A deployment pattern slightly outside the BRL generally is best for a small VA. In moving outward, the maximum mutual support distance is a limiting consideration. Mutual support is achieved when one fire unit covers the dead areas of its adjacent fire units.

b. The actual choice of positions to implement a defense must satisfy certain requirements. In CONUS, the area should be chosen with cost and availability of land in mind. Government owned land should be used where possible. Privately owned land is purchased where no public land is available. An unpopulated area near the battery site is desirable for NIKE-AJAX and NIKE-HERCULES booster disposal; however, the absence of such an area should not preclude the establishment of a proper defense (figs. 12 and 16 app. FM 44-1A). Battery sites must meet definite system requirements. NIKE-AJAX and NIKE-HERCULES batteries must have two areas with a clear line-of-sight between them. HAWK batteries will be concentrated along the likely low-altitude routes of approach.

c. Make a map and ground reconnaissance of the terrain in the vicinity of the emplacement pattern. This pattern should conform generally to the shape of the BRL. The search for suitable positions need not be confined to the trial pattern. The long range of the missiles and the requirement for mutual support between ad-

jacent fire units to create overlap in fields of fire is such that positions can be selected with great flexibility about the defended area. From the feasible positions under consideration, choose an ultimate defense position combination that generally conforms to the shape of the defended area. Mark the battery positions on an overlay and number them for identification.

d. The positions selected for battery sites must optimize radar detection and tracking capabilities. Site selection is of particular importance for low-altitude radar coverage. Considerations must include topographical variations, radar and target height, weather variation effects, and clutter densities. Theoretical coverage determinations should be verified when possible by the radar tracking of actual aircraft flights.

6. Terrain Difficulties

Designs for almost all defenses where missile units are deployed will encounter terrain difficulties. The two major categories of terrain difficulties are emplacement and masking. An emplacement difficulty is an area where a unit cannot be placed. A masking difficulty is an obstacle that limits radar-target line of sight. When either difficulty exists, certain modifications to basic defense design must be made.

7. Emplacement Difficulty

The planning phase for a defense involving an emplacement difficulty is the same as for a defense without an emplacement difficulty. Procedure difference begins with the designing phase. Disregarding the emplacement difficulty, plot the fire units equidistant apart in their optimum positions. Those units plotted in the unusable area are moved to the closest usable area. Because it has been necessary to move away from the optimum launcher position, the area over the emplacement difficulty now becomes the most critical area of attack. Therefore, initially check the direction-of-attack lines over the emplacement difficulty for adequacy only. This procedure is explained in section IV of this appendix. If these direction-of-attack lines are inadequate, fire units must be repositioned to provide an adequate defense. Normally, fire units will be moved toward the emplacement difficulty to increase the density of fire and compensate for the loss of attack time. Check the entire defense for both balance and adequacy.

8. Masking Difficulty

When masking difficulties interfere with radar operations, it is necessary to determine whether or not the first burst can be

achieved at maximum effective horizontal range. In this computation, the mil relation formula (WORM) is utilized. If all units in the defense cannot achieve the first burst at maximum effective horizontal range, the burst locator alone cannot be utilized for defense analysis. Analysis of the capabilities of these units must be accomplished with special analyzing devices. These are the target flight scale and the missile trajectory scale. Their construction and use is explained in section V. In order to utilize the maximum potential of the NIKE-AJAX and NIKE-HERCULES system, the following compromise in the selection of positions should be considered. Place the fire control area in a position where radar masking is at the minimum and position the launching area so that the maximum capability of the missile system in its primary field of fire is retained. The position of the unit should contribute the maximum number of bursts to the defense.

Section IV. THE EVALUATING PHASE

9. Evaluating Phase Procedures

a. The initial choice of positions is now evaluated for its military worth. Draw a minimum of 16 radial direction-of-attack lines equidistant apart through the center of the VA. Analyze the defense effectiveness against attack from each direction by placing the center of the burst locator (the threat) over the appropriate point. The construction of the burst locator is contained in section V. For the manned aircraft, this point is the intersection of the direction-of-attack line and the BRL. For the air-to-surface missile, the point of analysis is the intersection of the direction-of-attack line and the edge of the VA. Rotate the burst locator until the direction-of-flight arrow is pointed toward the center of the VA. Record the number of bursts that each fire unit under the burst locator contributes to the defenses of the area. Then total the number of bursts for all batteries and record this total for that direction-of-attack line.

b. For NIKE-AJAX and NIKE-HERCULES defenses, check the balance to see if the defense has approximately the same strength against each direction of attack. Check the strength of the defense to see if it is inadequate against any direction of attack. In sectors where strength is low, move fire units closer to that direction-of-attack line or outward toward the approaching target. In sectors where strength is relatively high, move fire units away from that direction of attack or inward. If the burst figures at the BRL are high compared to the bursts required to destroy the specific threat, the individual positions can be moved outward to increase effective-

ness against multiple attacks and improve early destruction factors. When fire units are repositioned, it is generally necessary to reanalyze the defense. A *guide* for determining balance is that no direction of attack should have more than plus or minus 10 percent of the average number of bursts. For HAWK defenses, balance is not an employment consideration since fire units are positioned along the low-altitude routes of approach.

10. Kill Contour

Next, an analysis is made to locate the points where the required number of missiles (computed M_t) required to kill the estimated threat, as determined in the planning phase, is achieved. This analysis is accomplished by moving the burst locator inward toward the BRL until the number of missiles needed to kill the threat is obtained. Plot these kill points on each direction-of-attack line and connect the kill points to form the kill contour. When compared to the BRL, the contour indicates the adequacy of the defense and can be used to compare this particular choice of positions with other choices that generate different kill contours. Label the contour with the number of aircraft kills achieved. At the bottom of the map or overlay, indicate the speed and altitude of the portrayed attack.

11. Analysis Computations

The evaluation determined the balance and adequacy of the defense against the threat. An analysis is now made using the burst locator. Each direction-of-attack line is analyzed at the BRL. The lowest reading represents the number of missiles the defense can deliver before the threat reaches any point along the BRL. This capability is M_t' .

a. To determine the number of targets the defense is capable of killing solve for m' : $m' = \frac{M_t' \times OR.}{n}$

b. To determine the kill assurance of this defense capability solve for K_a : $K_a = 1 - (1 - \text{SSKP})^{m'}$.

c. To determine the number of targets that can be killed with the originally specified kill assurance solve for n' : $n' = \frac{M_t' \times OR.}{m}$

d. To determine the *minimum* operational reliability the defense could maintain and still retain its effectiveness solve for OR' : $OR' = \frac{M \times n.}{M_t'}$

12. Integrated Defense

a. *General.* There are several factors that will determine whether or not two defenses may be integrated. These factors

are the size of the VA, range of the defense weapon, average distance from the center of the VA to fire units on the perimeter of the defense, number of units to be utilized in the defense, and the distance between the two VA's.

b. Determination Computations. The formula $D \leq 1.7 (d^1 + d_2)$ may be used to determine if the defenses of two VA's may be integrated.

D is the distance between the center of the two VA's.

d^1 is the average distance from the center of VA number 1 to fire units on the perimeter of VA number 1, considering it as an isolated VA.

d_2 is determined in the same manner for VA number 2.

This is only a guide, the final determination is dependent upon the actual employment and the evaluation of the defense.

c. Characteristics. An integrated defense will either utilize fewer fire units or greatly increase the firepower of an existing defense. Weapons deployed around one VA must contribute to the defense of the other VA if integration is to be accomplished. The planning tables used to determine the fire units required for isolated VA's are applicable *only as a guide* for integrated defenses. The determination of the fire units required for an integrated defense will be found by a trial procedure. Normally, the correct number of fire units can be determined by reducing by 25 percent the total number of fire units required for both VA's, considering each separately.

d. Design. To obtain balance with an integrated defense, it is necessary to deploy the units at the opposite ends of the two VA's. Fire units usually will not be deployed between the two VA's because some of the fire units defending one are supporting by fire some of the fire units defending the other.

e. Evaluation. The direction-of-attack lines drawn to evaluate an integrated defense are constructed by first drawing a line through the centers of the two VA's. Next, draw a line perpendicular to this centerline at the center of each VA. Now draw in an appropriate number of direction-of-attack lines on the outside halves of each VA (not more than 400 mils apart). Direction-of-attack lines are not normally drawn in between the two VA's. Any common direction-of-attack lines that intersect may be checked for adequacy, but they will not be used in computing figures for balance. When using a burst locator to evaluate an integrated defense, the bursts from the fire units that do not fall under the burst locator when oriented at the BRL but have contributed to the defense because the target has flown through

the field of fire of these fire units, must be considered. This contribution is known as tail effect.

13. Complexes

a. Planning. Because a complex is a series of integrated defenses, it may be necessary to accomplish the planning at a high air defense echelon to obtain the coordination necessary between defenses.

b. Design. The design of a complex may be accomplished by designing an integrated defense of two VA's and adding the defense of the third or more. In many complexes, only the outermost fire units will be integrated. In such case it is important that the inner fire units afford a balanced defense for the individual VA. This integrity of the defense will preclude occurrence of a gap in that defense or in several defenses should one be destroyed.

c. Evaluation. The construction of direction-of-attack lines for a complex defense can become involved unless the pattern of VA's forms a geometric figure. If the VA's form a line, then the direction-of-attack lines are constructed in the same manner as in an integrated defense. If the VA's form a geometric figure, such as a rectangle or triangle, then the direction-of-attack lines are drawn for the outermost portion of each VA. If no regular pattern is formed and there are many VA's the only direction-of-attack lines necessary are those that are the most likely to be used to attack each VA. The task of evaluating a complex may be involved, but the procedures are exactly the same as for an integrated defense.

14. Expansion

a. Deployment Pattern. The consideration for deploying units to attain a defense in depth, which will give early destruction of not only the delivery vehicle but also the weapon, and the flexibility to counter not only a simultaneous attack from one direction but also simultaneous attacks from many directions, may require an expanded defense. The range of NIKE-HERCULES allows deployment well out from the VA and at the same time retains the capability of massing fires against a mass attack from one direction. Deployment at considerable distance from the VA is further exploited to attain early kills. The deployment pattern for NIKE-HERCULES in CONUS is a circular pattern around the VA. The initial pattern is deployed just on or outside the BRL constructed for a gravity bomb delivered by the expected threat. To expand an existing defense, mutual support will be maintained between fire units laterally and radially. In large defenses where defense

in depth has been achieved, the outermost fire units may be displaced laterally to a maximum of full effective horizontal missile range. Radial displacement must not exceed mutual support distance.

b. Defense in Depth. Radial deployment of mutually supporting fire units provides depth to a defense. With some fire units deployed far from and some close to the VA, the defense will have early destruction capability by the outermost fire units and the flexibility to counter either a simultaneous attack from one direction or many directions. With the majority of fire units separated by no more than eight-tenths the missile's horizontal effective range, both laterally and in depth, mutual support and continuity of fire considerations are fulfilled. This type of deployment lends itself to augmentation by longer range weapons under consideration in feasibility studies. Weapons should be deployed as far from the VA as possible to obtain kills before the attack can become a real threat.

c. Evaluating Expansion. The evaluation of a defense containing more than one type of missile system requires a systematic technique. Analyze each type separately to determine balance. If all types are balanced, then the overall defense will be balanced. The analysis for balance should be made at the BRL, reading the burst locator value for each fire unit regardless of any limitation to the system. To determine the kill capability of a composite defense for a particular direction of attack, analyze the missile system with the longest range first. Evaluate the kill capability of each type of warhead, considering the most lethal first. Repeat this process for the lesser range missiles and determine the total number of hostile airborne objects killed by each missile system and warhead. The total number of targets that the composite defense can destroy along a particular direction-of-attack line is equal to the sum of the totals for each weapon system against that direction-of-attack line.

15. NIKE-HERCULES Defense Evaluation, Field Army

Evaluation of a NIKE-HERCULES defense in a field army can be accomplished as an evaluation of a specific installation or point or as an evaluation of the entire field army area.

a. Evaluation of a specific installation or point is accomplished in the same manner described for a VA except that the radius of effect of the maximum weapon threat must be added around the point, resulting in a VA to be defended.

b. Evaluation of the entire field army area is made at the boundary for the appropriate directions of attack. A field army is

provided air defense on the flanks by the adjacent field armies and to the rear by COMMZ. Direction-of-attack lines are constructed approximately 15 kilometers apart perpendicular to the FEBA and all exposed flanks. An isolated field army would require evaluation for all directions of attack.

16. HAWK Defense Evaluation, Field Army

The HAWK air defense of the field army is evaluated using the same type of burst locator as that used for the evaluation of a VA defense. The boundaries of the field army are used as the BRL was used for the evaluation of a VA. The evaluation is made for all expected low-altitude routes of approach. The capability of the defense is indicated by plotting kill contours for these specific threats (fig. 26).

17. Example: Designing and Evaluating a Defense With Terrain Difficulties

a. The VA in this example (fig. 27) is located in an area that presents two types of terrain difficulties. The ocean to the west presents an emplacement difficulty and the mountain to the north-east presents a masking difficulty.

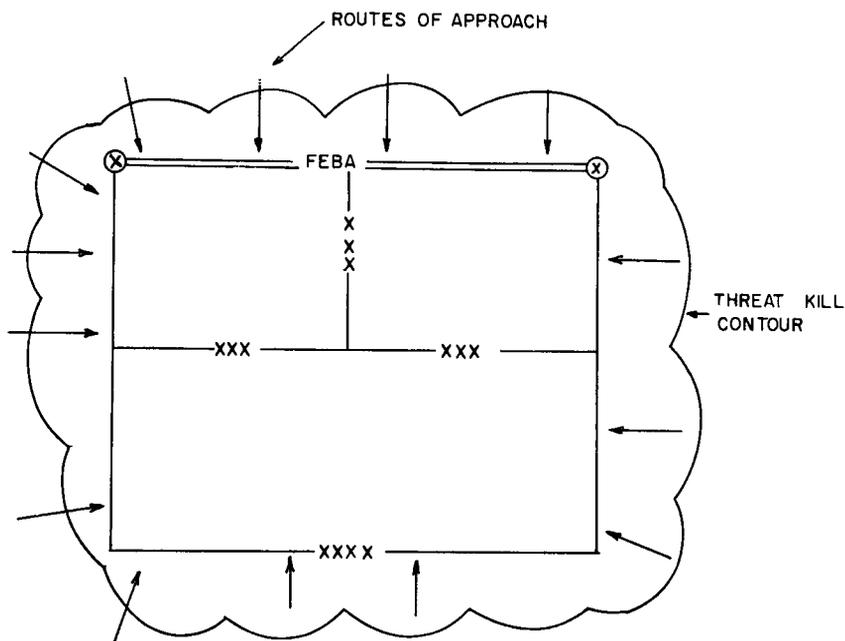


Figure 26. HAWK defense evaluation.

b. One NIKE-HERCULES battalion is allocated for the defense of this VA. The air defense commander desires a 99-percent assurance of killing the threat. The computed *OR* is 0.65 and the single-shot kill probability is 0.99. The enemy has the capability of attacking simultaneously with 8 aircraft at 600 knots at altitudes of 10,000 meters.

c. The planning phase begins by defining the VA. The bomb release distance is obtained from the bomb release distance graph and drawn around the VA. The circumference of the BRL is measured and divided by 6.28 (2 pi) to determine the average radius of the BRL. Enter the NIKE-HERCULES planning tables to obtain the desired location for the fire units. (In this example, locate sites on the BRL.)

d. Enter the probability table to determine the number of missiles required per target to attain the commander's kill assurance.

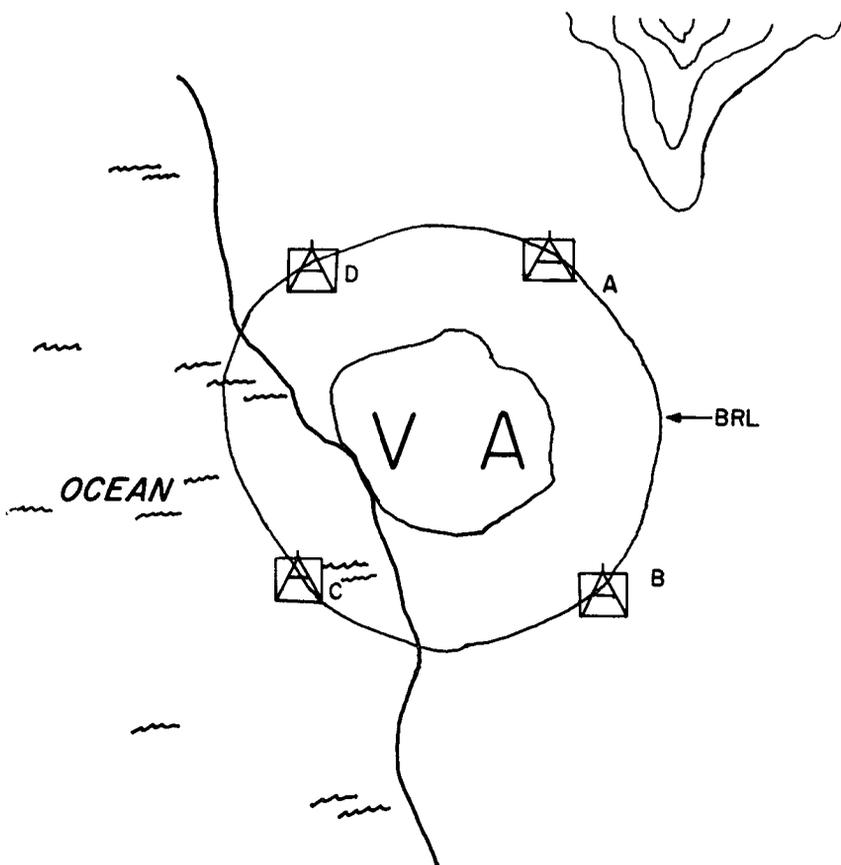


Figure 27. Define the VA and BRL.

ance of 99 percent: SSKP 0.99, K_a 0.99. The number required is one missile per aircraft. Determine the total number of missiles required against the threat to attain the commander's kill assurance of 99 percent:

$$\begin{aligned}
 M_t &= \frac{m \times n}{OR} \\
 &= \frac{1 \times 8}{0.65} \\
 &= 13 \text{ missiles}
 \end{aligned}$$

e. Plot the fire units disregarding the emplacement difficulty. Move the unit located in the emplacement difficulty to the nearest usable site (fig. 2). Using a burst locator constructed as described in section V, analyze the defense from the directions of the emplacement difficulty first for adequacy only. If the defense is adequate in the direction of the emplacement difficulty, analyze the defense in all directions for balance and adequacy. If the defense is inadequate in the direction of the emplacement difficulty, move the adjacent units a short distance toward the emplacement dif-

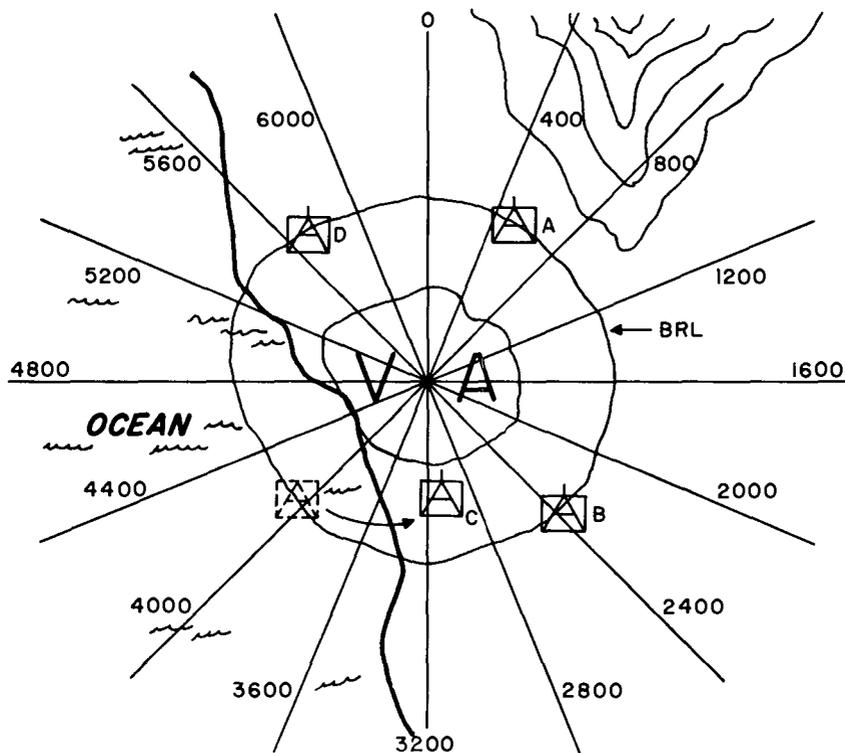


Figure 28. Plot the fire units.

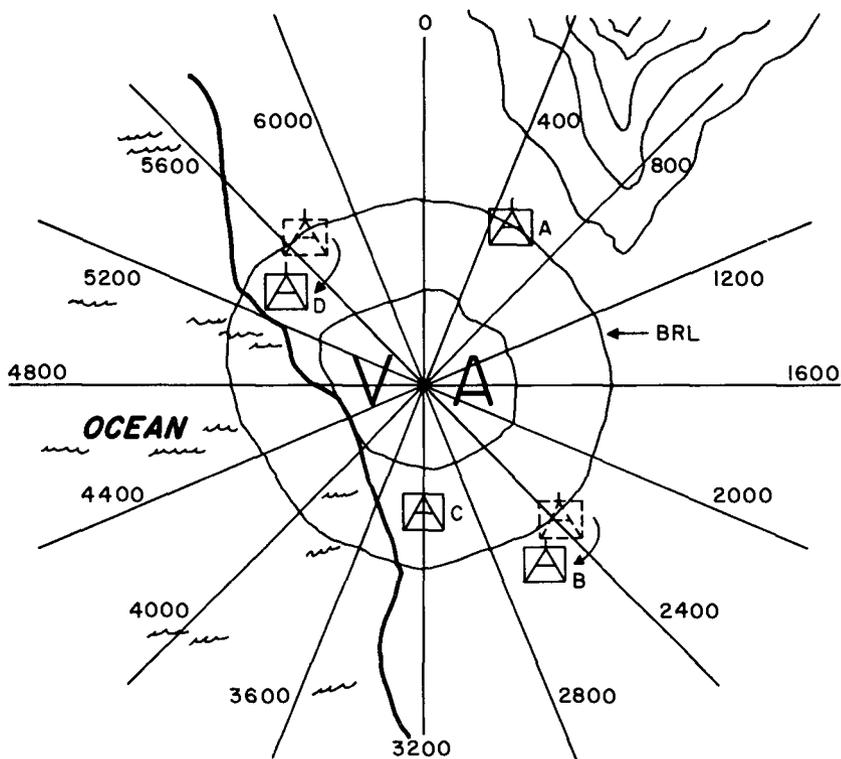


Figure 29. Relocate adjacent units.

ficulty, thereby increasing the weight of the defense in those directions (fig. 29). Again analyze the directions of the emplacement difficulty for adequacy only. After attaining adequacy in the directions of the emplacement difficulty by moving units, analyze the defense in all directions for balance and adequacy. Construct the kill contour by plotting the point where the threat receives the computed M_t of 13 missiles (fig. 30).

f. The mil relation formula (WORM) is used to determine if the mountain northeast of A battery will be masking difficulty (fig. 31). In order to attain maximum effective horizontal range of the weapon system, *an assumption for this example* is that the battery acquisition radar must be able to detect and transfer targets at 130,000 meters:

Altitude of the mountain is 4,000 meters.

Altitude of the battery is 50 meters.

Distance from the battery to the mountain is 50,000 meters.

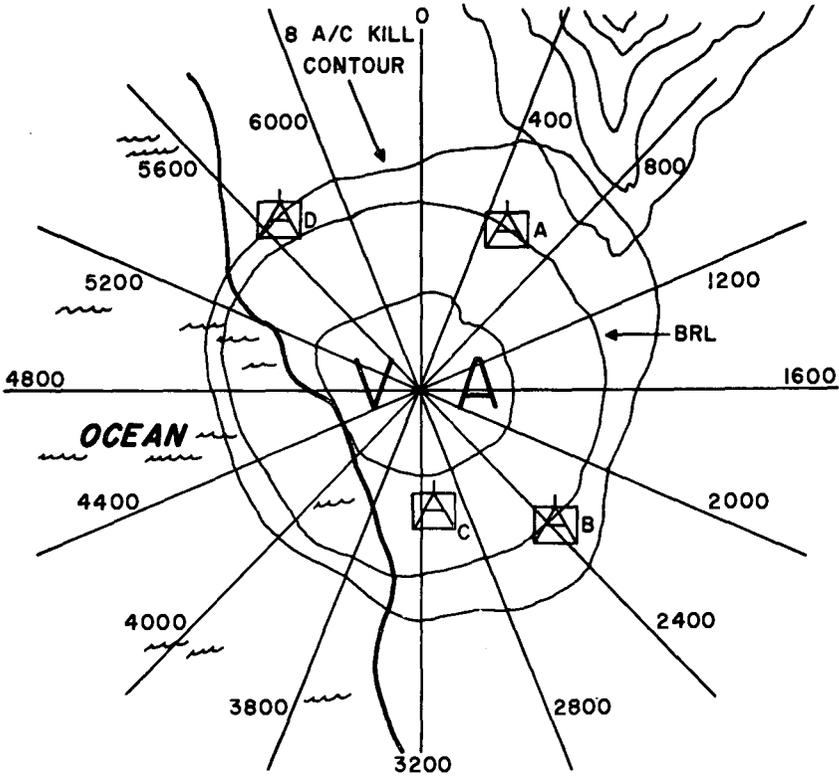


Figure 30. Construct the kill contour.

To determine the masking angle of the mountain, solve:

$$\begin{aligned}
 \eta &= \frac{W}{R} \text{ (altitude of mountain above the battery)} \\
 &= \frac{3,950}{50} \text{ (in thousand meters)} \\
 &= 79 \text{ mils masking angle.}
 \end{aligned}$$

To determine if the threat (altitude of 10,000 meters) can be detected at the required range of 130,000 meters, solve:

$$\begin{aligned}
 R &= \frac{W}{\eta} \text{ (altitude of threat above the battery)} \\
 &= \frac{9,950}{79} \text{ (masking angle)} \\
 &= 125.9 \text{ or } 125,000 \text{ meters.}
 \end{aligned}$$

Since the battery acquisition radar is masked from the threat until it is 125,000 meters from the battery, the maximum effective horizontal range of the weapon system cannot be reached. The burst locator designed for this threat is constructed incorporating

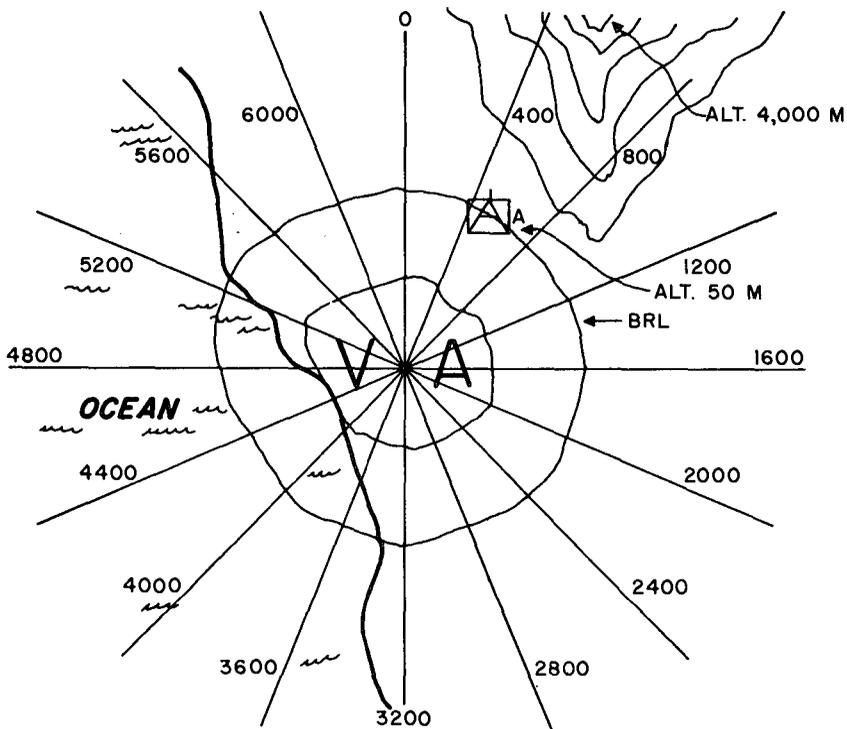


Figure 31. Masking difficulty.

the maximum effective horizontal range and therefore cannot be used to analyze this battery for this direction of attack. Special analyzing devices, the target flight scale and missile trajectory scale constructed for the threat, must be used.

g. The distance from the battery that the acquisition radar detects the threat (125,000 meters) is plotted on the overlay. System dead times are plotted from this point toward the VA to determine the position of the aircraft at the launch time of the first missile. These system dead times include time from acquisition to target tracked; time from target tracked to computer settled; and time from computer settled to launch. From this position, the time of flight on the target flight scale is matched with the missile time of flight on the missile trajectory scale to determine the location of the first burst. This procedure is accomplished as described in section V. The location of the second burst is obtained by including system dead time (the time from the first burst to the launch of the second missile by the same fire unit) and matching the times on the target flight scale and the missile trajectory

scale. This procedure is accomplished as described in section V. If the number of bursts from this battery and the number of bursts determined for the other batteries (using the burst locator) are sufficient to cause the kill contour to plot outside the BRL, the defense is adequate and the position of the battery in relation to the masking difficulties is satisfactory. If the kill contour does not plot outside of the BRL, the defense against that direction is inadequate. The battery or portions of the battery must be moved to improve the battery acquisition capability and thereby obtain adequacy.

h. In order to portray radar coverage accurately, consideration must be given to the curvature of the earth and the bending of the radar waves. By combining these two effects in the four-thirds earth curvature graph (fig. 32), radar rays may be drawn as straight lines.

i. Example:

(1) The battery radar is located at zero on the horizontal or

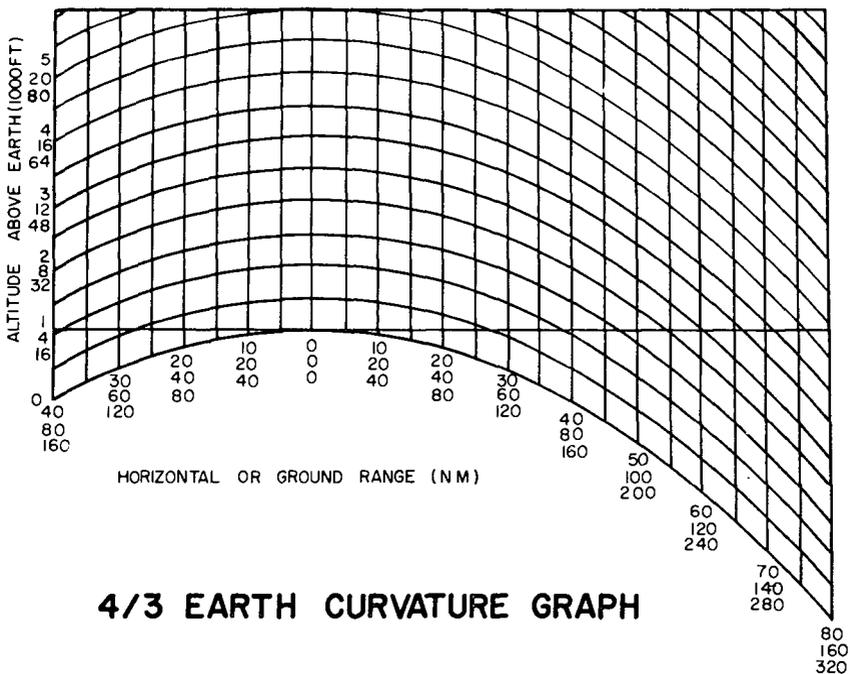


Figure 32. Four-thirds earth curvature graph.

ground range scale at an altitude of zero (mean sea level).

- (2) The target altitude (4,000 feet) is located on the altitude above earth scale as the center figure (4) in the bottom group of three figures. The corresponding curved line is traced to its intersection with the horizontal line. The horizontal line represents the radar horizon. Drop a vertical line from this intersection to the horizontal or ground range scale. Since the center figure of the group of three figures was used on the altitude above earth scale, the center figures must be used on the horizontal or ground range scale to determine the answer, which is approximately 77 nautical miles. This answer represents the range at which the target could first be detected by the radar without masking limitations.
- (3) This example can also be solved using the 4 appearing higher up the altitude above earth scale. Since it is the top figure of that group of three figures, the top figures on the horizontal or ground range scale must be used to determine the answer.

Section V. ANALYZING DEVICES

18. The Burst Locator

a. The burst locator (fig. 33) is a graphic portrayal of the summation of bursts as the target approaches and recedes from the range of a fire unit. Due to the many variables involved (ECM, earth curvature, masking, etc.), the burst locator should be used for a hasty analysis only. For a detailed and accurate evaluation, target flight and missile trajectory scales (special analyzing devices) must be used in conjunction with clutter and coverage diagrams. The curved contour lines on the burst locator connect initial points of an equal number of missiles. The spaces between contour lines represent the horizontal distance that the target travels during system dead time and missile time of flight. The numbered value of each contour line represents the number of missiles that a fire unit is capable of delivering against a target.

b. The radius of the burst locator represents the maximum effective horizontal range of the missile. The circumference of the analyzer represents the area coverage of a fire unit for whatever scale the locator is drawn.

c. Since the positions of the fire unit and the aircraft are relative, the target is assumed to be in the center of the burst locator

flying the direction indicated by the direction-of-flight arrow and direction-of-flight line.

d. It is assumed that all target courses are parallel to the direction-of-flight line indicated. The analyzer is read to the whole burst. *Do not* interpolate between contours. A fire unit outside contour line 1 is indicated as zero since this unit is not yet within range. Conversely, a fire unit to the rear and outside the limits of the burst locator has been within range, therefore it is given a value by extending a parallel direction-of-flight line from the fire unit location to the circumference of the analyzer and assigning an appropriate value at the point of intersection. The construction of this parallel line or lines for units that have been within range is called the tail effect of the burst locator.

e. It will be necessary in most cases to prepare a burst locator for the specific conditions to be encountered. Knowing a specific condition of attack for a particular area, a target flight scale and a missile trajectory scale are first constructed. The two scales are then used to construct the burst locator.

19. Target Flight Scale

In the construction of the target flight scale, the distance that a target will travel in a given period of time based upon a particular map scale and target speed is graphically represented as illustrated in figure 34. Target distance traveled in 100 seconds is arbitrarily used for convenience in computation and scale construction. The following mathematical computations produce the desired map distance in inches per 100 seconds:

a. Step A. The target speed in knots (nautical miles per hour) is multiplied by 1.8532 (converting knots to kilometers per hour), producing the product of target flight speed in kilometers per hour.

b. Step B. The result of step A is divided by 36 [obtained from $(60 \times 60 \div 100)$], producing the target flight speed in km/100 sec.

c. Step C. The target flight speed in km/100 sec is divided by the map scale in thousands to produce map distance in meters/100 seconds.

d. Step D. The map distance in meters/100 seconds is multiplied by 39.37, resulting in the map distance of the target speed in map inches/100 seconds.

Example: Given: Target speed 600 knots and map scale RF 1:250,000.

Problem: Determine graphic distance in inches representing this target.

Equation:
$$\frac{\left(\frac{600 \times 1.8532}{36} \right)}{250} \times 39.37 = 4.86 \text{ inches per } \begin{matrix} 100 \text{ seconds} \\ (12.34 \text{ cm per} \\ 100 \text{ seconds}). \end{matrix}$$

Note. The distance the target will travel in 100 seconds is graphically shown by placing the 0 (target) near the right side rather than at the left of the scale for convenience of use. The 100 seconds is subdivided into equally spaced increments to indicate the distance the target will travel in 10 seconds, 5 seconds, or even 1 second. Normally, a 5-second interval is used on target flight scales. The divisions to the right of the 0 are similar to the left and are used in connection with the system dead time (app. FM 44-1A). The scale is valid at any altitude.

20. Missile Trajectory Scale

a. The missile trajectory scale is constructed by extracting the time of flight (seconds) from the time-along-trajectory graph for the particular altitude and weapons system (figs. 9, 10, and 14, app. FM 44-1A). Unlike the target flight scale, the missile trajectory scale must be reconstructed whenever large variations in altitude occur. Map scale range in kilometers is constructed as horizontal range, and the time-along-trajectory is projected to correspond to the given range on the missile trajectory scale (fig. 35).

b. On the missile trajectory scale, the launcher position or zero time is shown at the left. Appreciable horizontal movement does not occur for the NIKE-AJAX and NIKE-HERCULES scales until about 20 seconds have elapsed, since the missile is initially moving vertically. Note that the distance the missile travels in a given period of time varies because the missile speed does not remain constant.

c. The missile trajectory scale places the characteristics of the particular system into the constructed burst locator.

21. Matching Times on the Scales

The principal use of special analyzing devices is to match the time of flight of the target with a corresponding time of travel of the missile. For example: A missile is launched from position A, (fig. 36) at the time that an aircraft is at position B; place the missile trajectory scale with the launcher position at A and the 0 on the target flight scale at B. The missile will meet the target

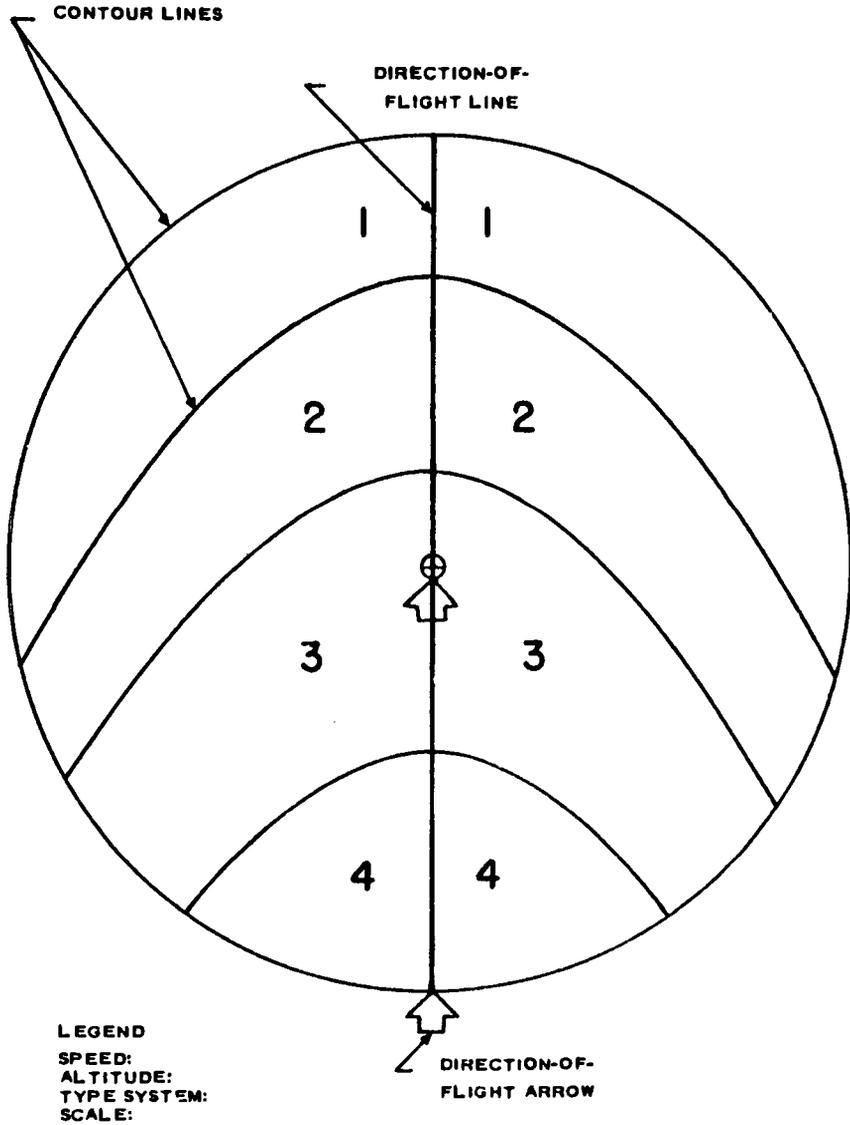


Figure 33. Type of burst locator.

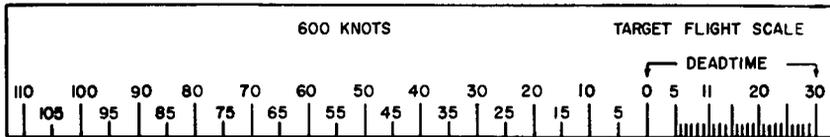


Figure 34. Target flight scale.

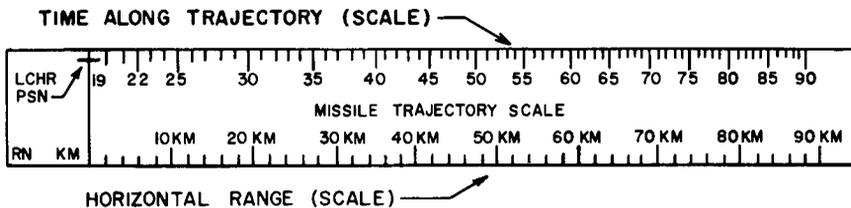


Figure 35. Missile trajectory scale.

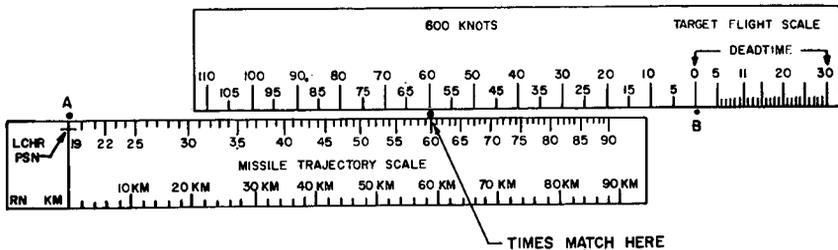


Figure 36. Burst locator scales.

where the two times correspond. (They will meet after the target and missile have each traveled for 60 seconds as shown in figure 36.)

22. Construction of the Burst Locator

(fig. 37)

a. Draw a series of parallel lines to represent the direction of attack. An arbitrary point is selected to represent the center of the fire unit launching area. Around this point describe a circle whose radius is equal to the maximum effective horizontal range of the missile system. This circle represents the initial burst contour.

b. The target flight and missile trajectory scales are used to

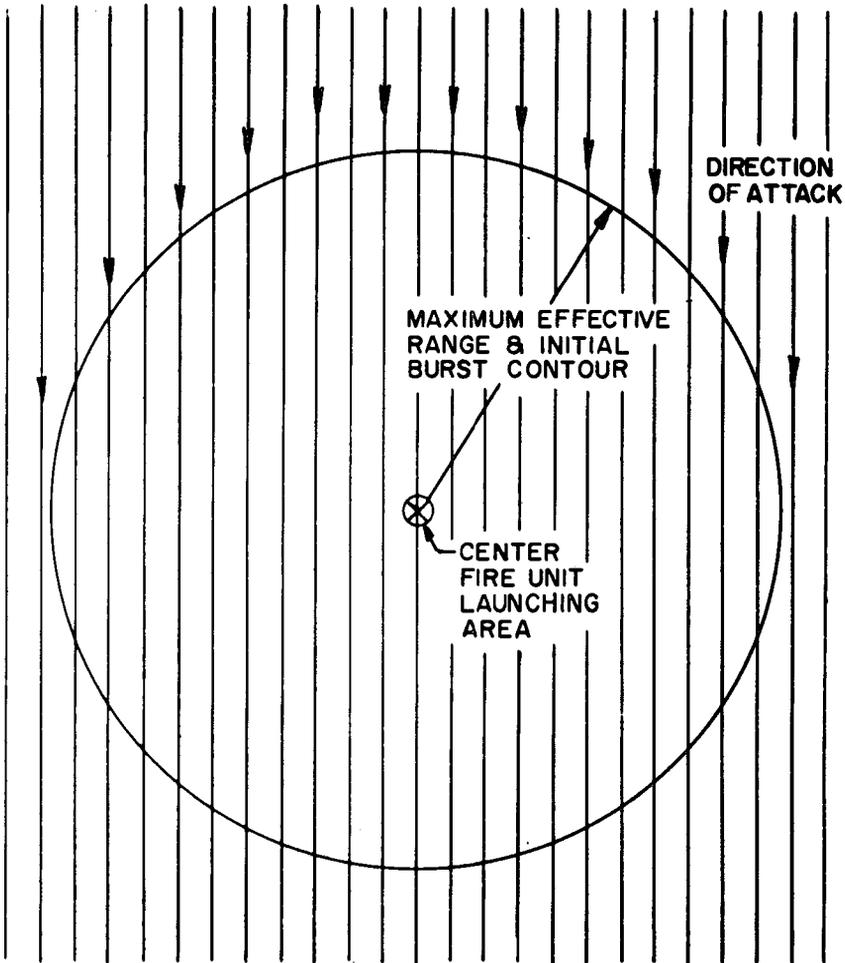


Figure 37. Burst locator (initial).

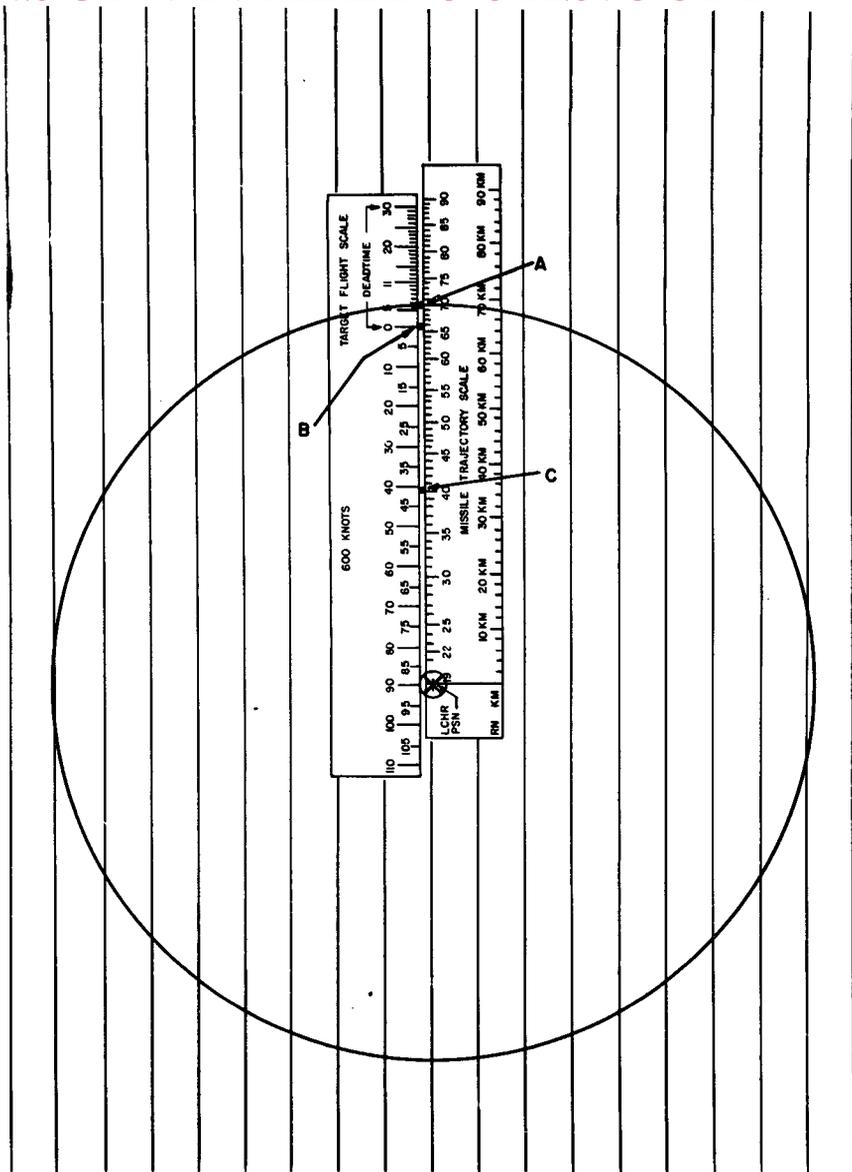


Figure 38. Burst locator with target flight and missile trajectory scales.

construct the position of the remaining burst contours (fig. 38). The launcher position (0) on the missile trajectory scale is oriented at the center of the burst locator. The target flight scale remains parallel to the direction-of-attack lines with the 0 mark inside the initial burst contour by the amount of system dead time. In figure 38 the initial burst occurs at point A. The target moves to point B

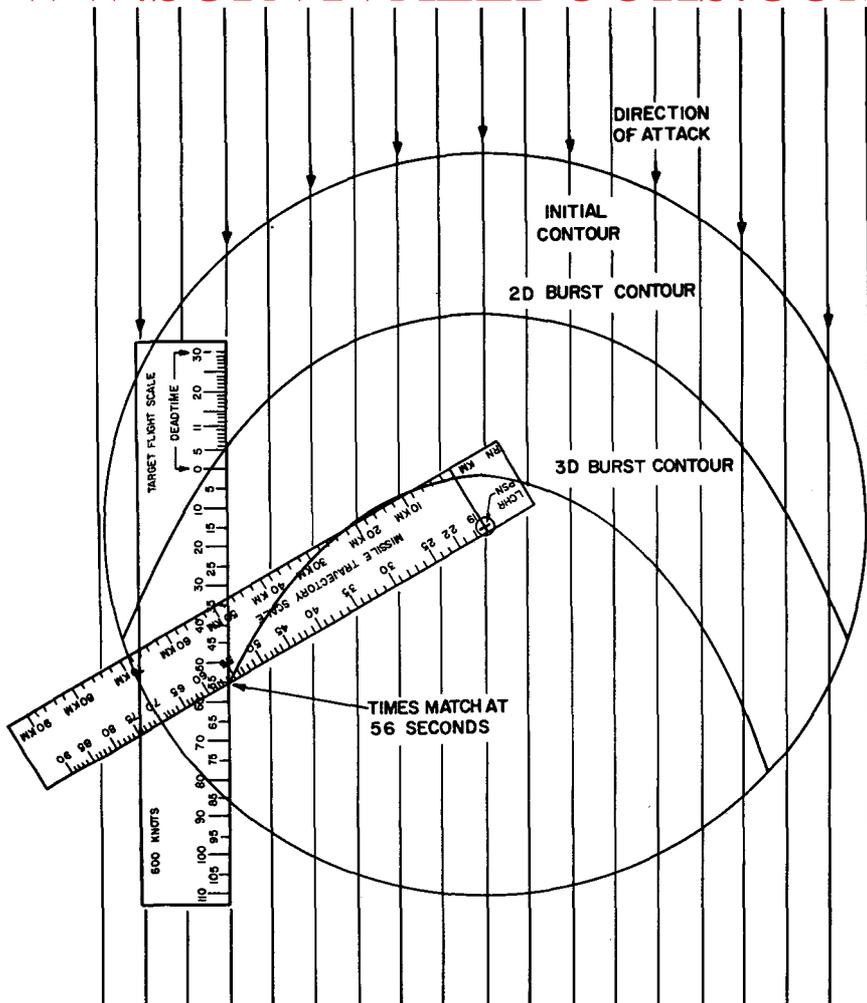


Figure 39. Completing burst contours.

before the same battery is able to launch its second missile. The target moves in for 40 seconds (missile time of flight) and the second burst occurs at point C.

c. To locate the remainder of the second burst contour, the target flight scale is oriented on each direction-of-attack line with the system dead time at the initial burst contour. The missile trajectory scale is then rotated until times are matched and marked as a second burst contour point. A contour is drawn connecting the second burst contour points, thus completing the second burst contour. This procedure is continued throughout the construction of the various contour lines of the burst locator (fig. 39).

23. Construction Variations

There are two variations that must be considered when constructing a NIKE-AJAX or NIKE-HERCULES burst locator.

a. The missile-track radar cannot be elevated a full 1,600 mils to a true vertical. This limitation creates a dead zone, and the missile must be programmed or skirted around this zone when directed at a target that is flying a course leading directly over the battery. The skirting delay is computed and accounted for automatically within the fire control system; therefore, a minor time adjustment is required when plotting a burst that occurs after the target has passed directly over the battery (burst locator center). The system dead time used must be increased by the amount of time required for the missile to skirt the dead zone. The shape of the appropriate burst contour is influenced by the additional skirting turn time so that an elongated U appears in the bottom half of the burst locator. The U becomes increasingly longer as the target approaches the bottom half of the maximum effective horizontal range circle (fig. 40)

b. The location of the initial burst contour may be altered under certain conditions of attack due to maximum range limitations of various radars. When this variation occurs, the maximum effective horizontal range circle will not be coincident with the initial burst contour in the direction from which the aircraft is approaching. This lack of coincidence must be determined before constructing the maximum effective horizontal range circle.

c. To ascertain where an initial burst might occur, assume that a fire unit acquires a target at a range of 160,000 meters in any direction and initially tracks the target at a distance of 140,000 meters. A delay of several seconds is necessary before launching to allow for computer settling and fire command. Figure 41 shows the location of the target at point C when the first missile is launched from point A. Note that point C is short of point B, the theoretical maximum track radar range. The first burst will occur at point D, the point where the missile flight time measured from A matches the target flight time measured from C. This burst occurs at a range of 83,000 meters. Point D then represents the first plotted point of the initial burst contour. The outer ring will not be a perfect circle when the initial burst occurs short of the maximum effective horizontal range of the system.

d. The remaining initial burst plots may be constructed in a similar manner by first inscribing an arc whose radius is the maximum track radar range. Then, the target flight scale is placed

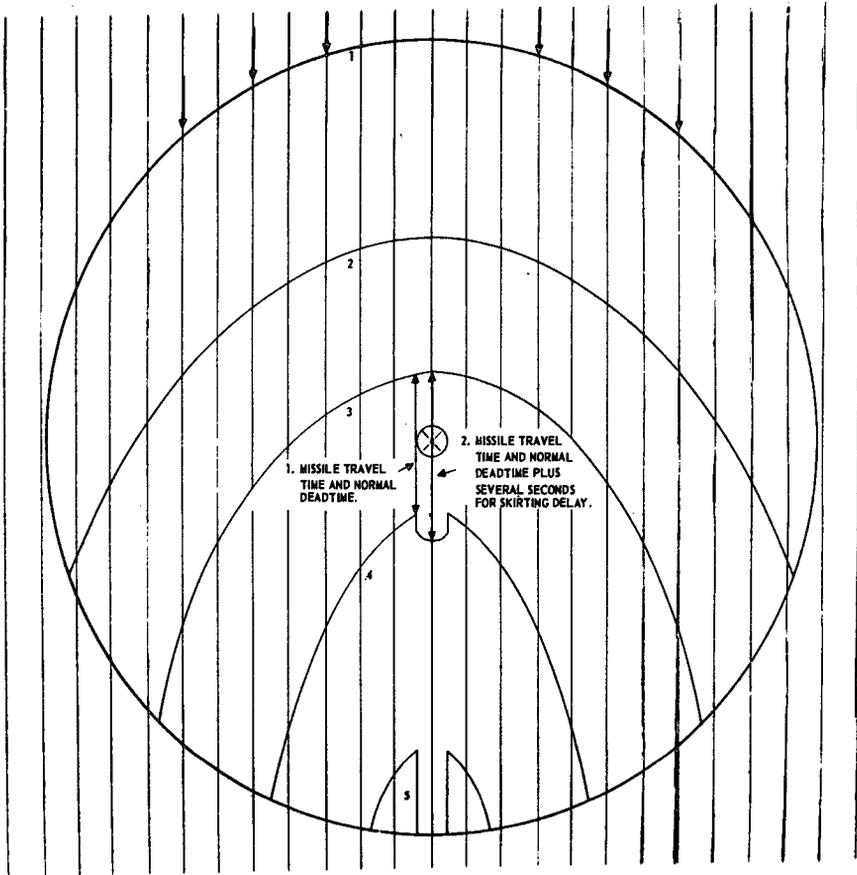


Figure 40. Dead zone and skirting turn time.

parallel to the direction-of-attack lines as in previous examples. Only the bottom half of the outer contour will appear as a circle since the closing velocity does not allow full range of the missile system to be achieved.

24. HAWK Burst Locator

(fig. 42)

a. Any defense design is tentative until an evaluation has been made to determine the adequacy of the design against a specific threat. Evaluation is accomplished by using an analyzing device (burst locator) to construct a graphic presentation of the effectiveness of the defense.

b. In preparation for the construction of a HAWK burst locator, a target flight scale and missile trajectory scale must be con-

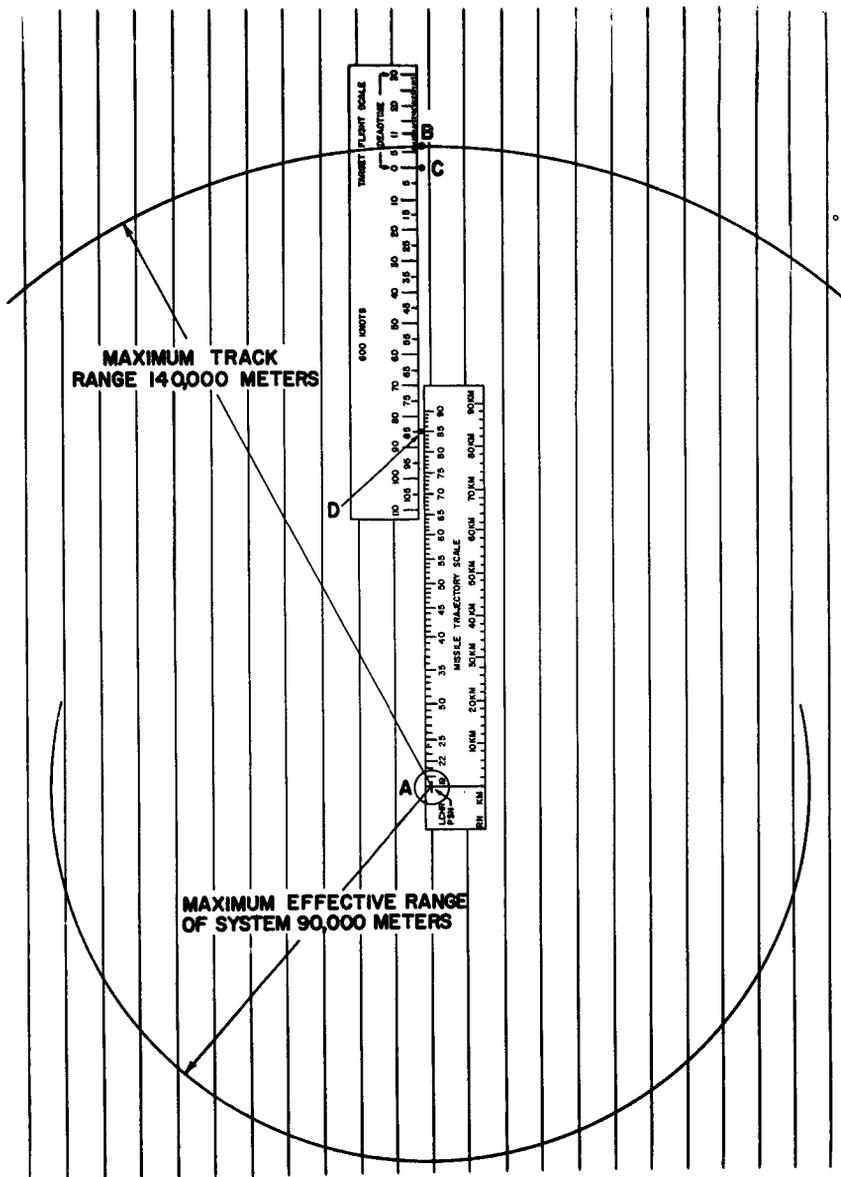


Figure 41. Initial burst contour range less than system maximum effective range.

structed, using the pertinent data for the weapon system (par. 1, app. FM 44-1A) and defense attack assumptions.

c. The target flight and missile trajectory scales are constructed in the manner previously described. The burst locator construction varies only after drawing the initial burst contour.

d. Should the unit tactical SOP dictate the expenditure of HAWK missiles in pairs against a single target, then missile capabilities can be graphically depicted by plotting the system dead time (par. 1a, app. FM 44-1A) from the initial burst contour along each direction-of-attack line and connecting these points: The second subscribed line connects the initial points where the second missile will be delivered on the threat. The burst contours of the initial pair of missiles will be close together.

e. The second pair of contours is constructed in a manner similar to that previously described and then adding the second missile contour of that pair as described in *d* above. This procedure is used to obtain the remainder of the burst contour pairs. Caution must be taken in plotting the contour points for the direction-of-attack line passing over the burst locator center (launching area). Engagements cannot be made within the minimum attack range of the system (varies with target altitude).

f. This type burst locator construction ignores the inability of system to fire while the illuminator radar is in the memory period, and the maximum gimbal limit limitations imposed by the target tracking antenna aboard the missile (par. 1d, app. FM 44-1A).

25. Use of the HAWK Burst Locator

Since the positions of the fire unit and the aircraft are relative, the *target* is assumed to be in the center of the burst locator flying in the direction indicated by the direction-of-flight arrow and direction-of-flight line. In using the burst locator, it is assumed that all target courses are parallel to the direction-of-flight line indicated. Also, the fire unit must be able to achieve the first burst at maximum effective horizontal range. The analyzer is read to the whole burst. *Do not* interpolate between contours. Since a HAWK battery has two illuminator radars and can track two targets, the value read for each battery is doubled. A fire unit outside contour line 1 is read as zero since the target is not yet within range. Conversely, a fire unit at the bottom of the analyzer has been within range. This tail effect is given a value by extending a parallel direction-of-flight line from the fire unit location to the circumference of the analyzer.

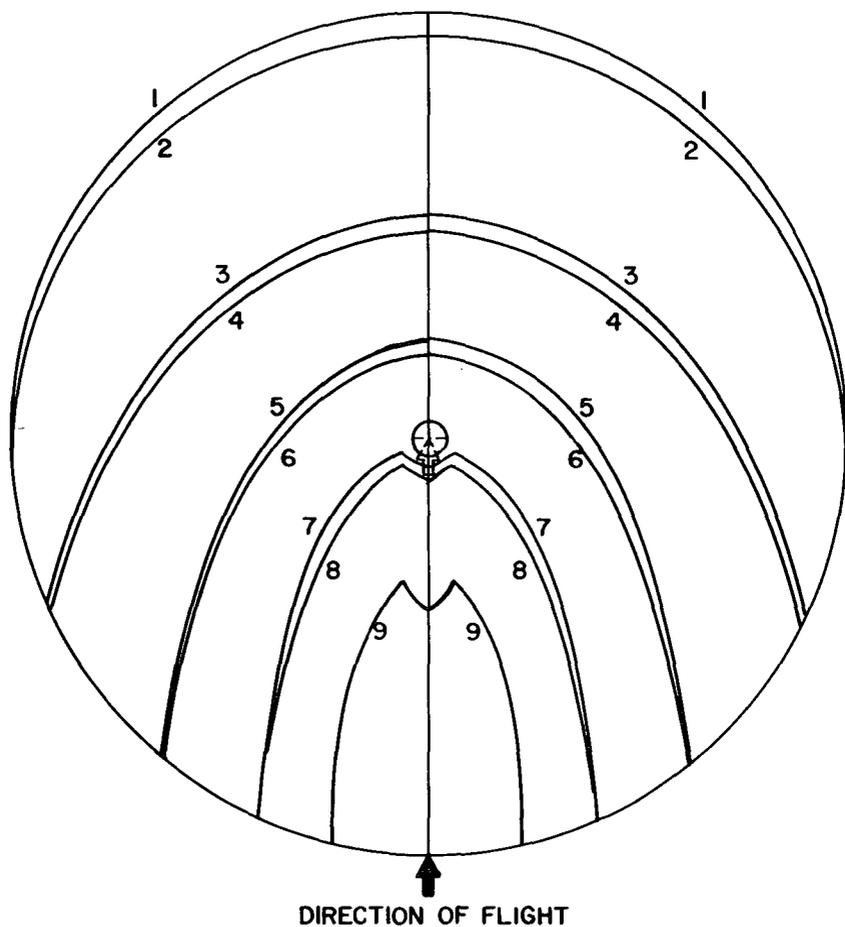


Figure 42. A type of HAWK burst locator.

26. HAWK Defense Analysis

a. Prepare an overlay of the proposed battery positions to a scale matching that of the burst locator. The battery symbol is plotted on the overlay in such a manner that its center is over the center of the fire unit launching area.

b. Inscribe the BRL around the VA and draw in the routes of approach. The BRL is the critical line outside of which the de-

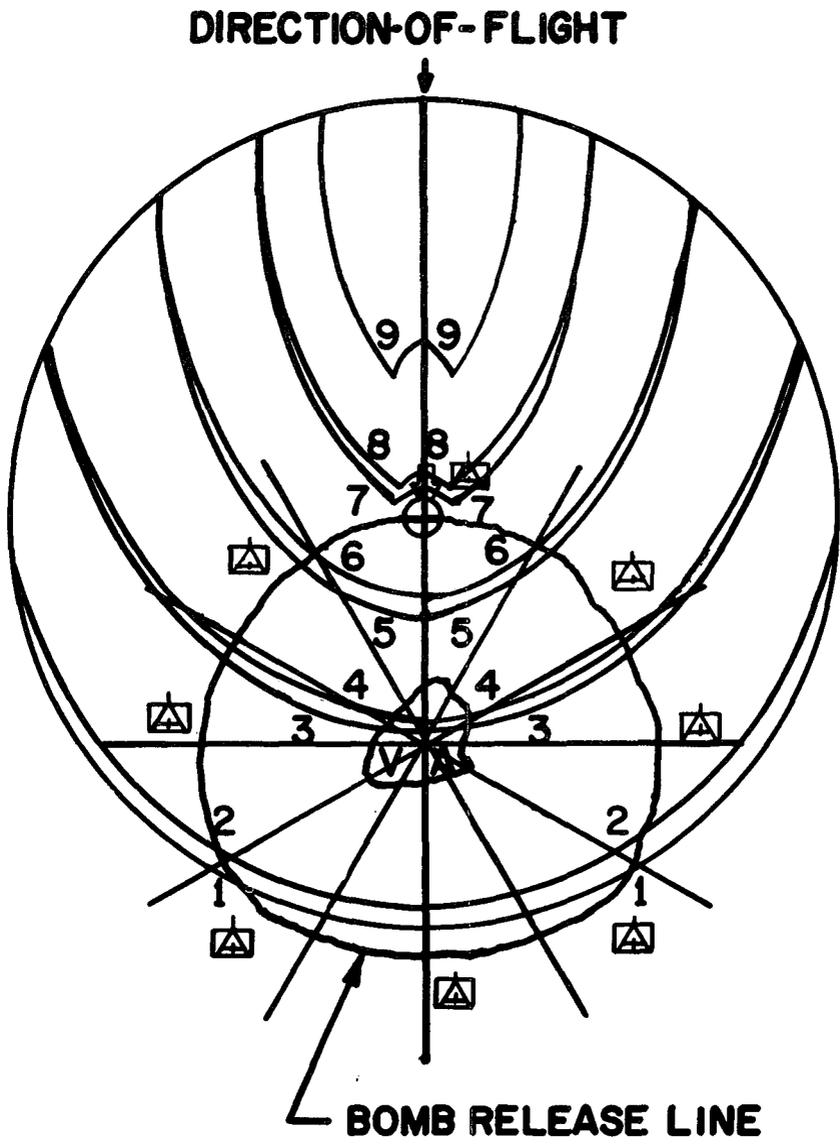


Figure 43. Burst locator oriented over a route of approach.

fense must destroy all enemy airborne objects to effect denial of penetration.

c. Place the burst locator over the defense overlay and orient the center (target) on the BRL. Place the direction-of-flight line over the route-of-approach line being analyzed with the direction-of-flight arrow pointed toward the VA. Read the burst value total as it appears on the burst locator (figure 43). *Double* the reading to obtain the number of bursts for a HAWK battery. (The number of bursts the target would receive by the time it reached the BRL in figure 43 is 38.)

d. Record the bursts for each individual fire unit. Total the number of bursts for each route of approach and record this total on the overlay near the intersection of the route of approach and the BRL.

27. Kill Contour

a. After completing the analysis at the BRL, construct a kill contour for the specific threat. This contour line should be constructed by using the computed M_t that gives the desired assurance of killing the threat.

b. Starting out of range of the nearest fire unit, superimpose the burst locator on the overlay so that its direction-of-flight line coincides with one of the routes of approach on the overlay and the arrow labeled direction-of-flight is pointed toward the center of the defended area. Slide the burst locator inward along the route of approach until the total number of missiles required to kill the threat is first obtained. The computed M_t will first be achieved when a fire unit (any fire unit) provides this total figure by falling under a contour line (any contour line). Mark the center of the burst locator on the overlay. That mark indicates the point where the target has received the desired number of missiles. Continue this process for all routes of approach and finally connect all the determined points with a smooth continuous curve. This contour becomes the kill contour for the specific threat computed.

c. Inspection of the results of the kill contour will determine the effectiveness of the defense design and its adequacy (ability to destroy specific threat at or outside the BRL).

APPENDIX III

EMPLOYMENT OF AIR DEFENSE ARTILLERY GUNS

Section I. CLASSIFICATION OF GUNS

1. Caliber and Weight

Air defense artillery guns are classified according to caliber and weight as light, medium, and heavy. Self-propelled versions are rated in the same category as the trailed version.

a. Light Air Defense Artillery. Air defense artillery pieces (usually under 90-mm) weighing less than 20,000 pounds (trailed mount including on-carriage fire control).

b. Medium Air Defense Artillery. Air defense artillery pieces (90-mm or larger) weighing less than 40,000 pounds (trailed mount excluding on-carriage fire control).

c. Heavy Air Defense Artillery. Air defense artillery pieces (larger than 90-mm) weighing more than 40,000 pounds (trailed mount).

2. Transport

Air defense artillery guns are classified according to means of transport as towed and self-propelled.

a. Towed Air Defense Artillery. Air defense artillery pieces designed for movement as trailed loads behind prime movers.

b. Self-Propelled Air Defense Artillery. Air defense artillery pieces permanently installed on vehicles that provide their motive power.

Section II. DEFENSE DESIGN FACTORS

3. Balanced Defense

The enemy is capable of attacking from any direction or altitude; however, he will seek to attack from the direction and altitude that is most favorable to him. Every effort must be made to attain a balanced defense equally effective in all directions against the threat. Deployment of a gun ring (GR) or rings around the vital area aids in providing balance.

4. Maximum Attrition Rate

Unlike AD missile defenses ADA gun defenses are not able to effect denial of penetration and the maximum possible attrition rate must be attained. Attaining this rate requires that medium and heavy fire units be placed as near the optimum GR as possible, based on the expected conditions of attack.

5. Continuity of Engagement

ADA gun defenses are designed against aircraft delivering conventional weapons. For this reason the vital area is not enlarged by the effects of the nuclear weapon threat. The enemy should be engaged continuously from the earliest possible moment until the final moment of bomb release. Even though a hostile aircraft is not destroyed, it may be diverted from its mission or drop its bombs with such error as to miss the most important parts of the VA. The dead area of a fire unit must be covered by the fire of at least one of the adjacent fire units.

6. Engagement of Targets

The maximum number of targets must be engaged. The fire unit commander selects targets not already engaged by other weapons of the defense. Engagements should be broken off promptly and new targets engaged when new targets offer a greater threat to the defended area or offer a more vulnerable target to the fire unit.

7. Routes of Approach

Cover the most likely routes of approach. Often a route of approach for hostile aircraft is dictated by terrain or weather. When routes of approach can be determined, weapons should be sited to provide greater strength in those areas. This must not be done, however, at the expense of weakening other portions of the defense below the minimum requirements.

8. Selection of Positions

Whenever possible, positions should be so selected that other missions can be performed from these positions without jeopardizing the air defense mission. When employment in the surface mission is expected, positions should be selected to carry out both the air defense mission and the surface mission.

9. Basic Considerations

The basic considerations in the disposition of Skysweeper fire units in order of their relative importance are:

- a. Provide balanced defense.
- b. Attain maximum effectiveness.
- c. Insure continuity of engagement.
- d. Engage the maximum number of targets.
- e. Cover expected routes of approach.
- f. Select positions that will permit the performance of other missions without jeopardizing the accomplishment of the air defense mission.

10. Planning Factors Table

(table IV)

The Skysweeper planning factors table (PFT) provides a guide for the number of 75-mm fire units necessary to provide a required level of defense for a VA of given size and provides a recommended disposition for these fire units. The PFT may also be used as a guide for the allocation of fire units to a defense. The PFT presented herein is based upon the 11-round, 600-mph, 6,000-foot altitude fire unit analyzer (FUA). If any other Skysweeper FUA is used, the optimum location of weapons is obtained by the trial-and-error procedure of analyzing trial GR's at various distances from the VA. The trial GR that gives the highest index number, consistent with a 2,400-yard (2,230-meter) mutual support distance between fire units, will be the optimum GR.

Table IV. Planning Factors Table (75-mm)

Radius of VA (yards)	9 fire units	Ind	12 fire units	Ind	15 fire units	Ind	18 fire units	Ind
500	9 @ 3,500	10	2 @ 500 10 @ 3,800	13	2 @ 500 13 @ 4,900	17	4 @ 500 14 @ 5,400	21
1,000			2 @ 1,000 10 @ 3,800	10	2 @ 1,000 13 @ 4,900	15	4 @ 1,000 14 @ 5,400	17
1,500					4 @ 1,500 11 @ 4,200	11	4 @ 1,500 14 @ 5,400	15
2,000							5 @ 2,000 18 @ 4,900	12
2,500								
3,000								
3,500								
4,000								
4,500								
5,000								

Radius of VA (yards)	21 fire units	Ind	24 fire units	Ind	27 fire units	Ind	30 fire units	Ind	33 fire units	Ind
500	4 @ 500 17 @ 5,500	24	4 @ 500 20 @ 5,500	28	4 @ 500 23 @ 5,500	32	4 @ 500 26 @ 5,500	35	4 @ 500 29 @ 5,500	39
1,000	4 @ 1,000 17 @ 6,000	21	4 @ 1,000 20 @ 6,000	24	4 @ 1,000 23 @ 6,000	27	4 @ 1,000 26 @ 6,000	30	4 @ 1,000 29 @ 6,000	33
1,500	4 @ 1,500 17 @ 6,500	19	4 @ 1,500 20 @ 6,500	22	4 @ 1,500 23 @ 6,500	25	4 @ 1,500 26 @ 6,500	28	4 @ 1,500 29 @ 6,500	32
2,000	6 @ 2,000 15 @ 5,800	15	6 @ 2,000 18 @ 6,900	19	6 @ 2,000 21 @ 7,000	22	6 @ 2,000 24 @ 7,000	25	6 @ 2,000 27 @ 7,000	28
2,500	7 @ 2,500 14 @ 5,400	12	7 @ 2,500 17 @ 6,500	16	7 @ 2,500 20 @ 7,500	21	7 @ 2,500 23 @ 7,500	23	8 @ 2,500 25 @ 7,500	25
3,000	8 @ 3,000 13 @ 4,900	9	8 @ 3,000 16 @ 6,100	13	8 @ 3,000 19 @ 7,200	18	8 @ 3,000 22 @ 8,000	21	8 @ 3,000 25 @ 8,000	24
3,500			10 @ 3,500 14 @ 5,400	9	10 @ 3,500 17 @ 6,500	13	10 @ 3,500 20 @ 7,600	17	10 @ 3,500 23 @ 8,500	20
4,000					12 @ 4,000 15 @ 5,800	9	12 @ 4,000 18 @ 6,900	13	12 @ 4,000 21 @ 8,000	16
4,500							12 @ 4,500 18 @ 6,900	11	12 @ 4,500 21 @ 8,000	15
5,000									14 @ 5,000 19 @ 7,200	10

Note 1. Each 75-mm fire unit must be located within 2,400 yards (2,230 meters) of at least one other 75-mm fire unit.

Note 2. This table is for use with the 75-mm, 11-round, 600-mph, 6,000-foot altitude fire unit analyzer, dated 19 August 1954.

Note 3. Fire units placed on GR's as indicated by this table will provide for the engagement of the maximum number of targets and for continuous coverage up to the BRL and over the VA. When minor terrain difficulties exist, fire units may be moved not more than 500 yards (457 meters) from their optimum locations. When considering the inner GR, it is better to move fire units outward than inward. In considering the outer GR, there is no appreciable difference if guns are moved either outward or inward.

Note 4. The index numbers listed above were obtained by averaging 12 directions of attack (30 degrees apart). The average index number may not be obtained on each direction of attack.

Note 5. The index numbers listed above are not directly additive to the index numbers of other types of weapons.

Note 6. The effectiveness of a defense is not directly proportional to either an increase or decrease of index numbers or materiel. For example, 12 fire units in a defense do not necessarily give twice the effectiveness of 6 fire units.

Note 7. Except for the deployment of 9 fire units, weapons are deployed on 2 GR's:

a. One GR on the VA edge.

b. The second GR at the optimum location for maximum attrition rate, provided that such location is consistent with mutual-support distances. When only 9 fire units are available, all are deployed on an optimum GR consistent with mutual-support requirements.

Note 8. The optimum GR = BRL — 350 yards (320 meters). The optimum GR is not used unless continuity of engagement, maximum target handling capacity, and mutual support distances are first satisfied.

Note 9. A minimum defense is established when the average index value equals 9.0.

Note 10. Table distances are presented in yards. Use conversion tables in appendix II to obtain measurements in the metric system.

11. Fire Unit Analyzers (FUA)

a. FUA's are graphic overlays similar to burst locators used in missile defense designing and evaluating phases. They are used to facilitate the design and analysis of AD gun defenses. The index numbers on the FUA serve only as weighting factors and have no direct relationship to the kill probability of the weapon. Since the lethality element that is necessary for the determination of kill probability and attrition rate is not included in the FUA values, it serves only as a means for comparison of defense plans.

b. The FUA is used to measure the effectiveness of each fire unit in a defense as related to each direction-of-attack line. For a circular defense, the analysis of directions of attack at 30° intervals will provide an adequate sampling of the effectiveness of the defense. For a noncircular defense, the direction-of-attack

lines should be placed 30° or less apart and radiate from the corners of the VA. Additional direction-of-attack lines should be placed perpendicular to the flat sides of the VA and spaced 1,000 to 3,000 yards (914 to 2,743 meters) apart.

c. To orient the FUA, place it so that the direction-of-flight line is on the selected direction-of-attack line on the map with the direction-of-flight arrow pointed toward the VA. Move the FUA along the direction-of-attack line until the center cross is over the point where the direction-of-attack line intersects the BRL.

d. The direction-of-attack line is analyzed by reading the index value for each fire unit lying within the contours of the FUA. The sum of the individual fire unit contributions will be the total effectiveness of the defense for that particular direction of attack.

12. Skysweeper Fire Unit Analyzers

a. Design. The designs of the Skysweeper FUA's are based upon assumptions derived from manufacturer specifications, test firing by various agencies, technical studies, and enemy tactics and capabilities. Some of the more important assumptions are:

- (1) Aircraft speed: 600 mph.
- (2) Altitude: 1,000, 6,000, or 12,000 feet.
- (3) Rectilinear target course.
- (4) Cyclic rate of fire: 50 rounds per minute.
- (5) Engagement of single target with 11 or 22 rounds.
- (6) It is assumed that the engagements in (5) above will occur during the optimum portion of the target's course prior to bomb release.

b. FUA Description (fig. 44).

- (1) *Title.* The title of the FUA shows the weapon for which it is designed, date of design, and the assumed attack conditions.
- (2) *Direction-of-flight lines.* The line of dashes through the longitudinal axis of the FUA is the direction-of-flight line (D) and represents the course of the attacking aircraft. The arrow labeled Direction of Flight, BRL Centered (I), indicates the direction of flight of the attacking aircraft. The intersection of the horizontal line of dashes with the direction-of-flight line (G) indicates the location of the attacking aircraft. This intersection is usually referred to as the center cross.
- (3) *Dead areas.* The shaded area (H) represents the 75-mm gun system dead area. It includes the gun dead area and the radar dead area. The radar dead area is ex-

tended to the maximum horizontal range circle because a target lost in the radar dead area is not likely to be engaged by the fire unit a second time. Dead area considerations are similar to dead zone considerations in designing and evaluating missile defenses.

(4) *Maximum horizontal range.* The outer circle (E) is the

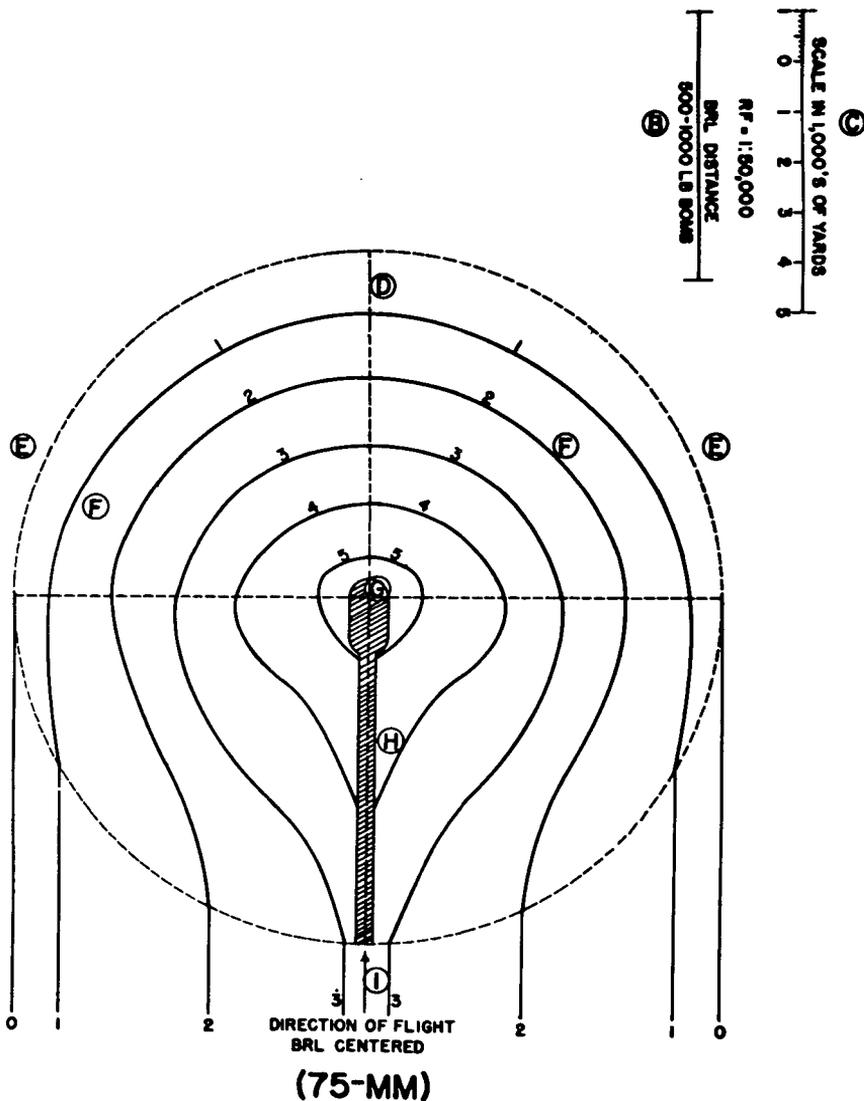


Figure 44. The 75-mm Skysweeper FUA. "11-round analyzer, 600-mph, altitude 6,000 feet, T-69 Skysweeper, straight and level course, 19 August 1954."

- maximum effective horizontal range of the fire unit for conditions of attack for which the FUA was designed.
- (5) *Contour lines.* The contour lines (F) connect points of equal effectiveness and are assigned index numbers.
 - (6) *Map scale of FUA.* The map scale of the standard FUA is 1:50,000 (C). Analyzers may be reproduced locally for use with maps of a scale other than 1:50,000.
 - (7) *BRL distance.* The BRL (B) must be located in order to determine the point farthest from the VA at which an aircraft launches its attack on that area. The BRL distance used on the FUA represents the horizontal distance from the edge of the VA to the BRL and must not be used as a BRL radius.

RECORDING FORM

VITAL AREA SAMPLE RADIUS IN YARDS 2,000

AVERAGE INDEX NUMBER (from ADA Planning Factors Table) 12

FIRE UNIT	DIRECTION OF ATTACK											
	0	30	60	90	120	150	180	210	240	270	300	330
1	3.50	2.50	.50								.50	2.50
2	2.75	3.50	2.50	.25								.50
3	.75	2.75	3.50	1.25								
4		1.00	.75	3.50	2.00							
5			1.25	3.00	3.50	1.75						
6				1.25	3.25	3.50	1.75					
7					1.50	3.25	3.25	1.50				
8						1.75	3.25	3.25	1.50			
9							1.75	3.25	3.00	1.25		
10								2.00	3.50	3.00	1.00	
11									2.00	3.50	2.75	.75
12	.75									2.25	3.50	2.75
13	2.75	.50								.25	2.50	3.50
14	1.25	1.00	.25								.25	1.00
15		.75	1.25	1.25	.75							
16				0.50	1.25	1.25	1.00	.25				
17						.25	1.00	1.25	1.25	1.50		
18									.75	1.25	1.25	.75
TOTAL INDEX NO.	11.75	12.00	10.00	11.00	12.25	11.75	12.00	11.50	12.00	13.00	11.75	11.75

Figure 45. Sample recording form.

ADA EFFECTIVENESS CLOCK

VITAL AREA SAMPLE
 RADIUS IN YARDS 2,000

DATE _____

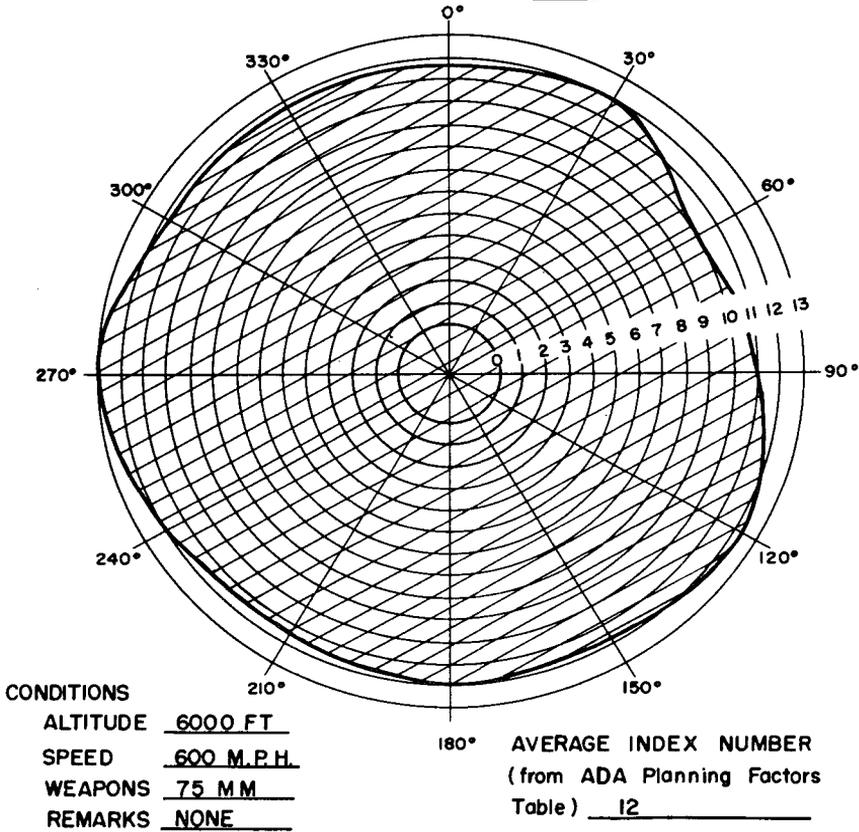


Figure 46. Sample effectiveness clock.

(8) *Index numbers.* The index numbers are arbitrary designations of the relative effectiveness of the 75-mm fire unit when firing at a target coming within maximum effective range of the weapon. These index numbers are not directly additive to index numbers for other types of weapons as obtained from their particular FUA.

13. Analysis Forms

For recording and graphically presenting the results of a de-

fense analysis; two forms, the recording form and the effectiveness clock are used.

a. Recording Form. By using the appropriate FUA, the index number contribution of each fire unit in the defense for each direction of attack is determined and tabulated on the recording form. Each direction-of-attack column is totaled to obtain the total contribution of all fire units for each direction of attack. Figure 45 is a sample recording form.

b. Effectiveness Clock. The defense analysis results are presented graphically by means of a polar coordinate chart. This effectiveness clock is graduated in angular increments corresponding to the direction-of-attack lines and radially in equally spaced concentric lines. The concentric lines are used to establish an index number scale. The shape of these lines corresponds to the shape of the BRL.

- (1) Having chosen an appropriate scale, the total index number for each direction-of-attack line as shown on the recording form is plotted and the points joined (fig. 46).
- (2) The index numbers on each FUA are designed so they may be added to obtain the average index numbers indicated in the PFT.
- (3) The graphical presentation will indicate the relative strength for each direction of attack in terms of relative index numbers, the balance or lack of balance of the defense, and whether the defense achieves the average index number as indicated in the PFT.

Section IV. DEFENSE DESIGN AND ANALYSIS, MEDIUM AND HEAVY ADA WEAPONS

14. Planning Factors Tables

(tables V and VI)

The methods and procedures for medium and heavy air defense artillery defense design and analysis are based upon the use of attrition rates. The optimum locations for fire units available insofar as the distance outward from the VA is concerned have been determined empirically by a consideration of attrition rates and are contained in PFT's. The PFT's serve as guides for the planning of gun defenses. Each defense must be tailored to the prevailing employment conditions in that area. The PFT's will indicate how available fire units can best be employed to exploit capabilities and minimize limitations under the varying conditions of attack as set forth in the notes to the table.

Table V. Planning Factors Table (120-mm)

Radius of VA (yards)	OGR* (yards)	Average index (15,000-30,000 ft. alt., 200-400 mph)				
		4 btry	6 btry	8 btry	12 btry	16 btry
0	3,000	28	41	55	82	
1,000	4,000	22	32	44	65	88
2,000	5,000		27	35	54	73
3,000	8,000		24	32	47	64
4,000	11,000		21	30	42	59
5,000	13,000			23	42	49

*Optimum Gun Ring.

Note 1. Each 120-mm fire unit must be located within 11,000 yards (10,058 meters) of at least one other 120-mm fire unit.

Note 2. When minor terrain difficulties exist, fire units should be moved not more than ± 1,000 yards (914 meters) radially.

Note 3. The index numbers listed above represent an average for the 12 directions of attack. The average index number may not be obtained on each direction of attack.

Note 4. Table distances are presented in yards. Use conversion tables in appendix II to obtain measurements in the metric system.

Table VI. Planning Factors Table (90-mm)

Radius of VA (yards)	OGR* (yards)	Average index (M2 index numbers—10,000 ft. alt.—400 mph)			
		4 btry	8 btry	12 btry	16 btry
0	3,000	59	118	176	235
1,000	3,000	48	94	143	190
2,000	6,000	36	76	114	152
3,000	7,500	32	62	96	128
4,000	7,500	27			
4,000	10,000		54	82	114
5,000	7,500	22			
5,000	10,000		50	74	102

*Optimum Gun Ring.

Note 1. Each 90-mm fire unit must be located within 7,500 yards (6,858 meters) of at least one other 90-mm fire unit.

Note 2. When minor terrain difficulties exist, fire units should be moved not more than ± 1,000 yards (914 meters) radially.

Note 3. The index numbers listed above represent an average for the 12 directions of attack. The average index number may not be obtained on each direction of attack.

Note 4. Table distances are presented in yards. Use conversion tables in appendix II to obtain measurements in the metric system.

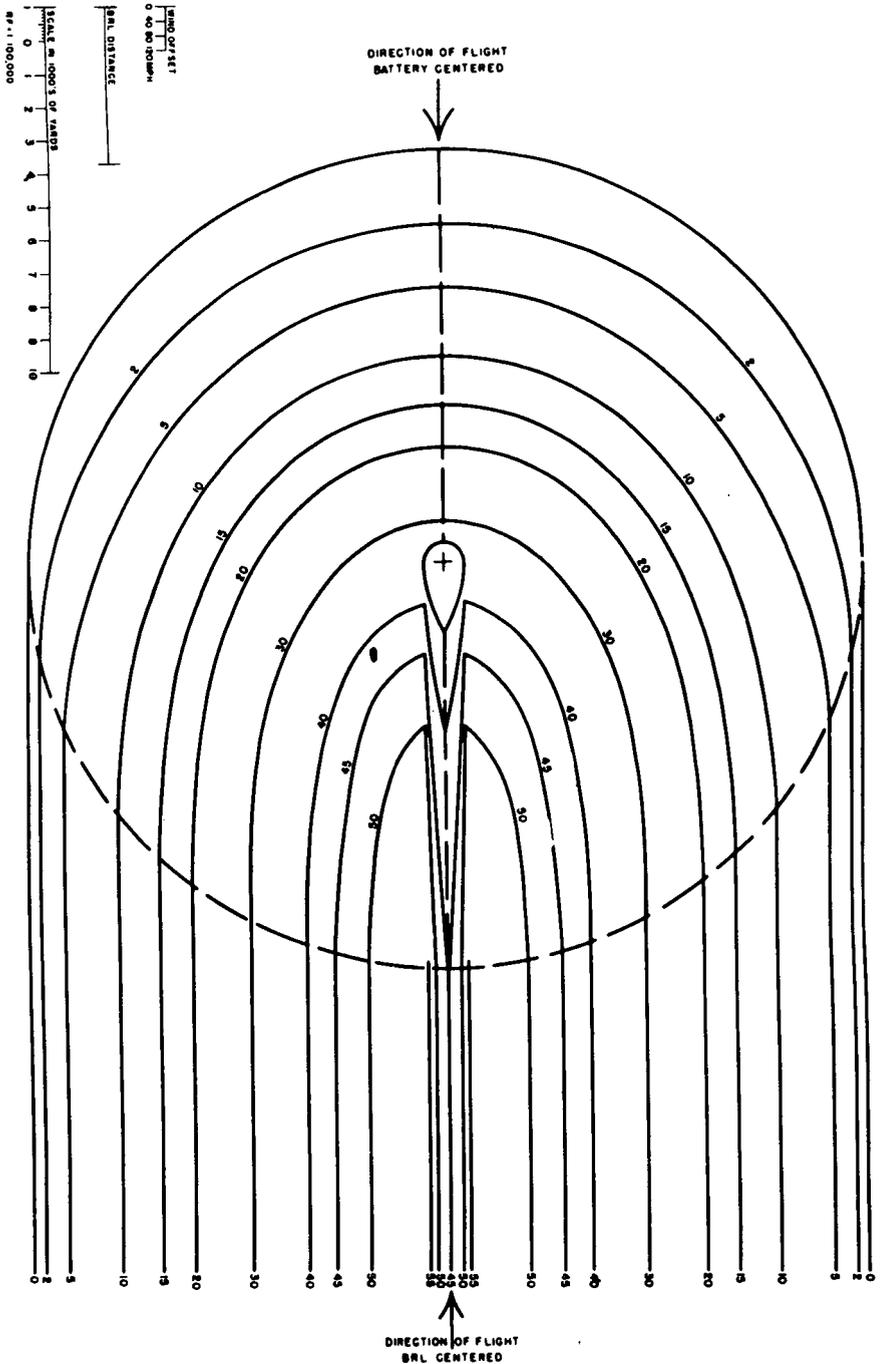


Figure 17. Fire unit analyzer, 90-mm gun. "M2 Sg 400-mph, altitude 10,000 feet, straight and level course, 6 November 1950."

15. Fire Unit Analyzers for Medium and Heavy Guns

(fig. 47)

FUA's for 90-mm and 120-mm guns are similar to those for the Skysweeper. FUA's designed for use with 90-mm and 120-mm gun defense designing are listed below according to the target altitude and speed characteristics.

a. 90-mm Gun FUA's.

- (1) 30,000 feet; 300 mph.
- (2) 30,000 feet; 400 mph.
- (3) 30,000 feet; 500 mph.
- (4) 25,000 feet; 400 mph.
- (5) 25,000 feet; 500 mph.
- (6) 20,000 feet; 300 mph.
- (7) 20,000 feet; 400 mph.
- (8) 15,000 feet; 400 mph.
- (9) 15,000 feet; 500 mph.
- (10) 10,000 feet; 400 mph.
- (11) 10,000 feet; 500 mph.
- (12) 5,000 feet; 300 mph.
- (13) 5,000 feet; 400 mph.
- (14) 5,000 feet; 500 mph.

b. 120-mm Gun FUA's.

- (1) 35,000 feet; 300 mph.
- (2) 30,000 feet; 300 mph.
- (3) 30,000 feet; 500 mph.
- (4) 25,000 feet; 300 mph.
- (5) 25,000 feet; 400 mph.
- (6) 20,000 feet; 300 mph.
- (7) 15,000 feet; 300 mph.
- (8) 15,000 feet; 400 mph.
- (9) 5,000 feet; 300 mph.

**Section V. DEFENSE DESIGN AND ANALYSIS, LIGHT
ADA WEAPONS****16. Duster, Forward Area Weapon**

a. General. The Duster (M42, self-propelled, twin 40-mm) is the FAW utilized in the air defense artillery automatic weapons battalion (SP) that provides a portion of air defense to the division area. Normally one battalion will be attached to each division. The senior attached battalion commander is the division air defense officer. Duster FAW's will be deployed with infantry, armored, and mechanized brigades, nuclear delivery means, march columns, critical points, and assembly areas.

b. *FAW Employed with Infantry, Armored, and Mechanized Brigades on the FEBA.*

- (1) *Defense gaps.* The enemy realizes that units will be dispersed on the nuclear battlefield, creating gaps between combat elements. Inadequate radar coverage at low altitudes over division fronts will provide the enemy with airspace in which he can achieve surprise and in which aggressive air attacks may persist. More specifically, terrain features create relatively safe lanes below the radar horizon. These safe lanes will certainly become expected routes of approach for hostile low-flying aircraft. Armed air reconnaissance, as well as other aircraft, will seek such routes, and they will be fully exploited as holes in the defense. Striving for denial of penetration calls for the immediate attack of aircraft in these lanes. The threat of vertical envelopment, aerial reconnaissance, and the enemy's use of close support aircraft require that the forward elements be provided AD to accomplish their mission. In addition to the high-performance aircraft, rotary wing and light aircraft may utilize these safe lanes. An aircraft may transport an artillery observer who is capable of adjusting accurate nuclear artillery fires into the division positions. Therefore, it is necessary that these fire units be located far forward in order to attack and destroy the enemy aircraft before they strike the division area.
- (2) *Allocation.* Inasmuch as the brigades will have a large area of responsibility with much of the terrain unoccupied, it is not feasible to allocate fire units based on the distance around its overall area. To compute the area to be defended (for allocation purposes), multiply the frontage (in meters) of the brigade by two and use this figure when referring to the PFT (table VII). This figure will provide sufficient fire units for the air defense of the units within the infantry, armored, and mechanized brigades.
- (3) *Design.* The deployment of the fire units will depend on the location of the various elements of the brigade. Where at all possible, the fire units should be located within the occupied areas. When some fire units must be emplaced elsewhere, coordination must be made with the infantry units to provide protection against ground attack for these fire units. The overall defense should be designed as a noncircular VA with the existing safe lanes as prob-

able routes of approach. The defense may be integrated with adjacent defenses depending on the distance between units.

c. *Duster Defense of Nuclear Delivery Means.*

- (1) *Allocation.* The actual area occupied by the nuclear artillery will vary with each position; however, each nuclear delivery means, whether of platoon or battery size, will require about a 1,000-meter grid square for the weapons, nuclear storage, and dispersion. Therefore, the allocation planning figure of six fire units based on a 4,000-meter perimeter is the minimum. The fire units will displace with the artillery and provide air defense on the march and in the new position. If a nuclear delivery means is occupying a larger area, additional fire units should be allocated for that particular defense. The defense of a nuclear delivery means should not be integrated; however, AD intelligence should be continuously provided.
- (2) *Design.* The defense normally will be designed as a VA having vital points; i.e., the weapons, storage areas, and troop areas.

d. *Duster Defense of March Columns.*

- (1) *Allocation and deployment.* Allocation planning is based on road space. An infantry brigade normally will occupy about 11 kilometers, requiring 12 fire units to provide the air defense, unless multiple routes of march are utilized. In the absence of detailed information, this figure may be used to plan weapon allocation. More fire units must be employed with the lead and rear elements of the column. To insure three weapons attacking any aircraft, it is necessary to place one fire unit in the first 100 meters of the column. The second fire unit is to be placed approximately 550 meters behind the first, and the third fire unit approximately 550 meters behind the second one. This arrangement provides three weapons close to the head of the column, all within mutual support distance. The same consideration should be given to the column rear. The remaining weapons should be dispersed throughout the column at 1,100-meter intervals to provide continuity of attack along the entire column.
- (2) *Allocation at critical points.* In addition to the fire units moving with the column, fire units must be placed at critical points along the route of march. Any location

where an effective air attack could stop the entire column must be provided additional protection. At bridges, defiles, and passes where it would be impossible to leave the road or bypass an obstacle, the enemy must be prevented from creating such an obstacle by attack from the air. Usually four fire units can protect these critical points, but more weapons may be required if the perimeter exceeds 2,750 meters. In some cases the point may be critical only for the time it takes for one march column to pass and not for extended periods of time. In such instances, four fire units may be allocated during the passage of the column, and then given another VA to defend.

e. Duster Defense of Assembly Areas. Inasmuch as the assembly will usually be in connection with a road march, fire units will normally have already been allocated for the march column. These weapons will also be used to provide air defense in the assembly area. If additional fire units are required, they should be allocated and arrive at the assembly area prior to the arrival of the other units. The defense is designed as a VA with vital points.

f. Special Considerations in Employment of Duster.

- (1) The location of nuclear kill areas in relation to the location of the fire units requires special consideration. A nuclear kill area is an area into which the commander intends to canalize the enemy to attack him with nuclear weapons. The situation at any given time will dictate the coordination required. At times it may be necessary to place fire units within the danger area to cover safe lanes, which will require close coordination with the supported unit.
- (2) Close coordination is required for selection of position areas, communications, and other administrative matters between the various levels of air defense commanders and respective levels of command in the supported unit.
- (3) The capability of the FAW to fire surface missions must be considered when, in the opinion of the commander concerned, the requirement for ground support is greater than air defense support and during times of poor visibility when they cannot fire air defense missions. Such arrangements as are required should be made to move fire units into the perimeter of a supported unit and to tie in with its ground defense plans. The location of other air defense means will not affect the design of the defense but will affect the allocation of the FAW's.

- (4) The last consideration is that of ammunition, both the basic load and resupply. Where possible, assistance of the supported unit is desired in resupply of ammunition. The rate of fire of the 40-mm FAW (M42) can deplete the entire basic load of ammunition in a few minutes. This factor must be considered when determining whether or not to attack both aerial and surface targets.

g. Employment of Other Organic Elements.

- (1) One AN/GSS-1 electronic search central is organic to each SP battalion. As a guide in locating the radar, it is desirable that for optimum coverage it be emplaced from 9 to 27 kilometers behind the FEBA. This distance will provide adequate altitude coverage over the FEBA and maximize its range capability of approximately 300 kilometers. The position selected should provide if possible a reflecting surface that is level and moist to a radius of 3 to 9 kilometers from the radar and an antenna height of 5 to 120 meters above the surrounding terrain. The AN/GSS-1 antenna, mounted on the 2½-ton truck, is approximately 6 meters above the ground.
- (2) Another element available to assist in air defense is the the visual observer teams. These eight teams will be employed to fill gaps in the radar coverage, primarily the gap from ground-to-radar coverage and safe lanes. The OP's should be placed on the general outpost line (GOPL) at approximately equal distances (not over 5 kilometers). This location will provide approximately 30 seconds warning to fire units employed with the combat units on the FEBA. The information from the OP's will go to the fire units and may be forwarded to battalion, division warning system, and group AADCP.

17. Duster Defense Design Factors

a. The basis for air defense design is the enemy's probable course of action. The 40-mm FAW defense design is based on a dive or low-altitude attack with emphasis on the dive. The enemy, even though approaching at a low altitude, has the capability of various maneuvers during the attack of the target. The defense is designed for a 520-knot speed of attack approaching from any direction. Although the defense is designed for these tactics, the enemy can be successfully attacked and destroyed when using other tactics.

Table VII. Planning Factors Table—40-mm (M42) Fire Units

Perimeter of VA in meters	Number of fire units	Perimeter of VA in meters	Number of fire units
0- 2,750-----	4	21,601-22,700-----	36
2,751- 5,500-----	6	22,701-23,800-----	38
5,501- 7,300-----	8	23,801-24,900-----	40
7,301- 8,400-----	10	24,901-26,000-----	42
8,401- 9,500-----	12	26,001-27,000-----	44
9,501-10,600-----	14	27,001-28,100-----	46
10,601-11,700-----	16	28,101-29,200-----	48
11,701-12,800-----	18	29,201-30,300-----	50
12,801-13,900-----	20	30,301-31,400-----	52
13,901-15,000-----	22	31,401-32,500-----	54
15,001-16,100-----	24	32,501-33,600-----	56
16,101-17,200-----	26	33,601-34,700-----	58
17,201-18,300-----	28	34,701-35,800-----	60
18,301-19,400-----	30	35,801-36,900-----	62
19,401-20,500-----	32	36,901-38,000-----	64
20,501-21,600-----	34		

Note 1. Mutual support distance: 100-1,100 meters.

Note 2. Weapons are to be distributed in depth with some located as much as 200 meters outside the VA.

Note 3. For larger VA's, two weapons should be allocated for each increase of 1,100 meters, or fraction thereof, in the distance around the VA.

Note 4. For a stronger defense, additional weapons may be used and the distance between fire units decreased.

Note 5. A 100-meter displacement is permitted for minor terrain difficulties.

Note 6. The shape of the defense should conform generally to the shape of the VA.

Note 7. The minimum number of weapons for a defense is four fire units. Additional weapons will be allocated in increments of two.

19. Initial Position Template

(fig. 48)

To assist in designing the 40-mm FAW defense, an initial position template is utilized. The template is constructed by placing weapons 1,100 meters apart in columns with each column 900 meters apart, then offsetting every other column 550 meters. The result is a dispersed pattern with no weapon more than 1,100 meters from any adjacent weapon, thereby providing mutual support for each fire unit from at least two other fire units.

20. Use of Template

a. The template should be used to assist in designing the defenses. Place the template on a map of proper scale and adjust it so that most of the fire units allocated are in or near the VA.

Some weapons will fall a considerable distance from the VA. Move these weapons in toward the center of the VA until they are within 200 meters of the edge. A fairly smooth pattern of straight lines and diagonals, undesirable for the finished defense, will appear. Enough weapons in the defense must be relocated to avoid a design with continuous straight lines of fire units. Relocation may come about naturally because of minor terrain difficulties. When moving because of minor terrain difficulties or to break up the straight-line patterns, do not move weapons more than 100 meters in any direction. It is possible that in the completed design some weapons may be more than 200 meters from the edge of the VA.

b. Figure 49 illustrates the design of a simple defense using the initial position template. The same basic system is applicable to defenses involving special considerations.

Note. Any defense may be hand tailored by allocating weapons according to the PFT and considering mutual support distances. Generally, however, a more desirable defense is realized by using the initial position template.

- (1) The first special consideration concerns vital points within a VA. It is highly probable that, within a VA to be defended with 40-mm FAW, certain points will be more important than others. Within a VA may be nuclear weapon storage areas, nonnuclear ammunition, and guided missile storage. The missile and nuclear areas certainly are more important than the nonnuclear ammunition and open areas (fig. 50).

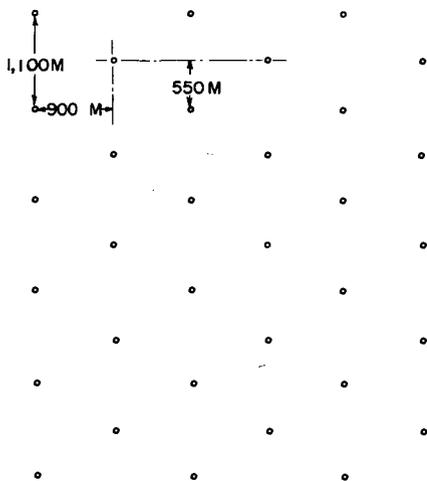


Figure 48. Initial position template.

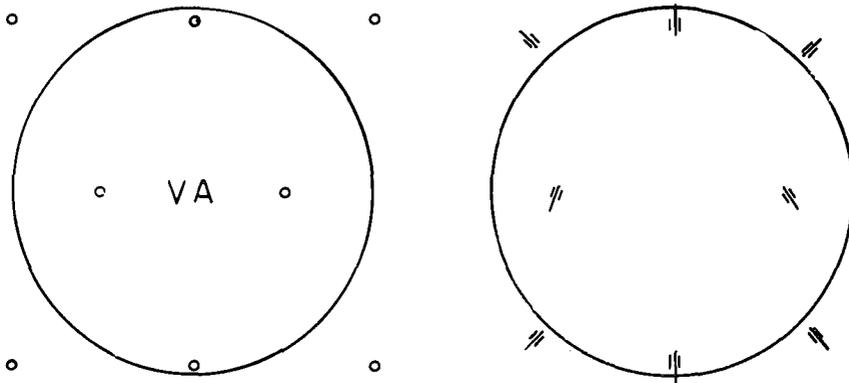


Figure 49. Simple defense.

- (2) In such cases, design the defense with fire units emplaced close to the vital points; i.e., adjust the template initially to favor the vital points. Any fire units that must be moved because of minor terrain difficulties should be moved toward the more important points.

c. When designing the defense of a noncircular VA, the defense generally should follow the shape of the VA. After defining the VA on a suitable map, determine the distance of its perimeter. Consideration should be made to minimize the perimeter distance; i.e., since the perimeter of a VA with an indentation gives a false picture of the total area to be defended, measure the shortest distance around the VA (fig. 51). Using this distance, find the number of fire units required, using the PFT. Next, place the template on the map and adjust it to provide the best balanced defense with the fire units allocated, placing some fire units inside and some outside the VA. Finally, as with the simple defense, bring the fire units within 200 meters of the VA and reposition enough to break up the straight line pattern. This action completes the defense design of a noncircular VA.

d. In some cases a long, narrow VA can be defended with less fire units than required by the PFT, for example: a VA 5,000 meters long and 400 meters wide with a total perimeter of 10,800 meters. The PFT calls for 16 fire units. However, by using the

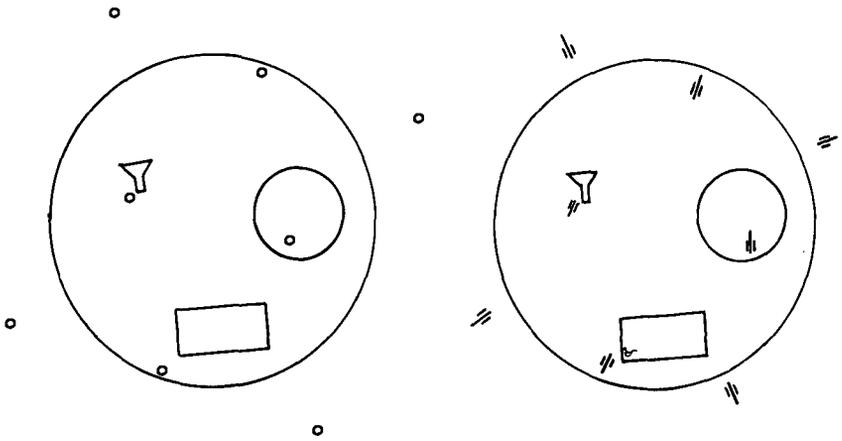


Figure 50. VA containing vital points.

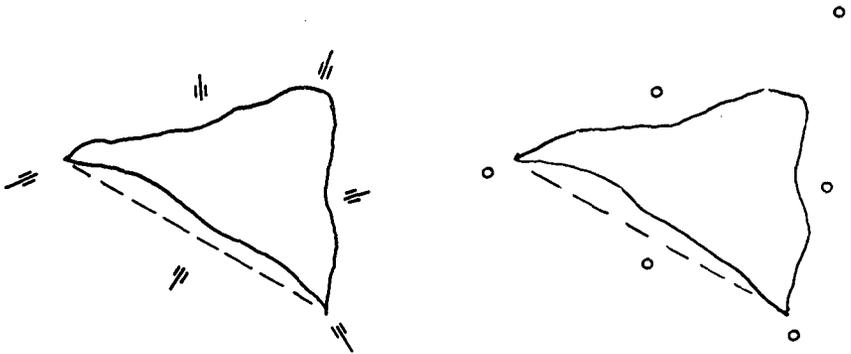


Figure 51. Design of defense for noncircular VA.

template, this VA can be defended with 10 fire units. The six left over may be used for an additional defense or defenses. This defense is the only type of VA that should be allocated fire units by using the template. The long, narrow VA is shown in figures 52 and 53.

e. Defenses will be integrated when the near edges of the VA's are within 1,300 meters of each other (fig. 54). The 1,300 meters were derived from the fact that fire units are located 200 meters outside the VA and the template is constructed on lines 900 meters apart. If the near edges of the VA are within 1,300 meters of each other, the defense is designed as a single defense by establishing a common perimeter of the two or more VA's. When designing, consider each VA as a vital point within the overall VA.

f. Major terrain difficulty requires special consideration. Design the defense, using the template, and disregard the major terrain difficulty. Move those fire units that are in the terrain difficulty and space them equidistant along its edge, considering the other fire units in the defense. In this way a balanced defense is maintained by increasing the volume of fire, thus compensating for the decrease in firing time. If other fire units must be moved because of minor terrain difficulties or to break up the straight-line pattern, they should be moved toward the major terrain difficulty.

g. The next special consideration concerns probable and forced routes of approach.

(1) The probable route of approach is one that the enemy is likely to use but does not necessarily have to utilize. The pilot of an aircraft traveling at 520 knots and 150 meters off the ground can see very little detail on the ground. He is able to see large objects such as highways, rivers, and mountain ranges. Because he can see landmarks of this nature he may use them to assist in navigation. If there are highways or rivers leading into the VA, they must be considered as probable routes of approach. To design a defense involving a probable route of approach, the template will be used in the normal manner except that it will be initially positioned to locate as many fire units as possible near the probable route. Balance is not disregarded when designing this type of defense. After positioning the template, any fire units that are to be moved up to 100 meters may be moved to favor the probable route.

(2) An example of a forced route of approach would be submarine pens that cannot be destroyed from overhead. They must be destroyed from low-level attack. Usually a single route of approach exists. Balance is disregarded when designing the defense for a forced route of approach and the defense for a forced route of approach and the defense is hand-tailored to fit the situation. Fig-

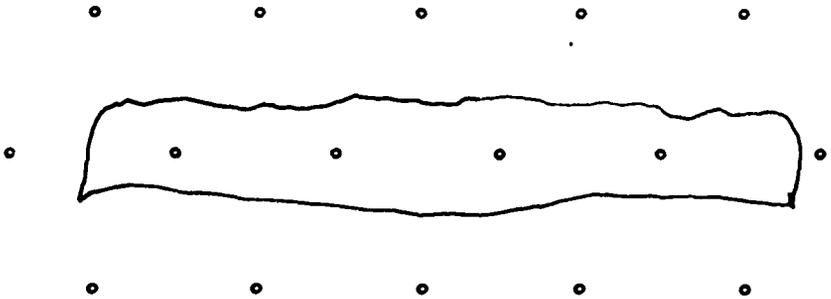


Figure 52. Allocation by PFT and initial positioning with template (16 fire units).

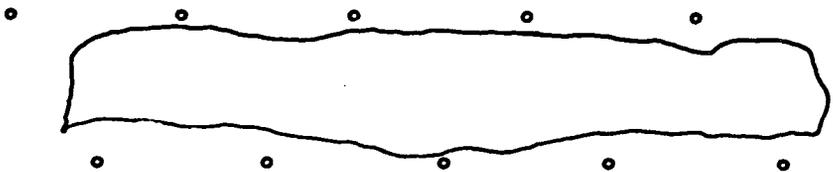


Figure 53. Allocation and initial positioning using the template only (10 fire units).

ure 55 depicts a forced route of approach with a typical defense design.

21. Target Selection

Because defenses are designed for a 4-second firing time, it is essential to delegate the authority for the selection of targets to the fire unit commander. In addition to the rules of attack, there are various standing operating procedures at all levels of command.

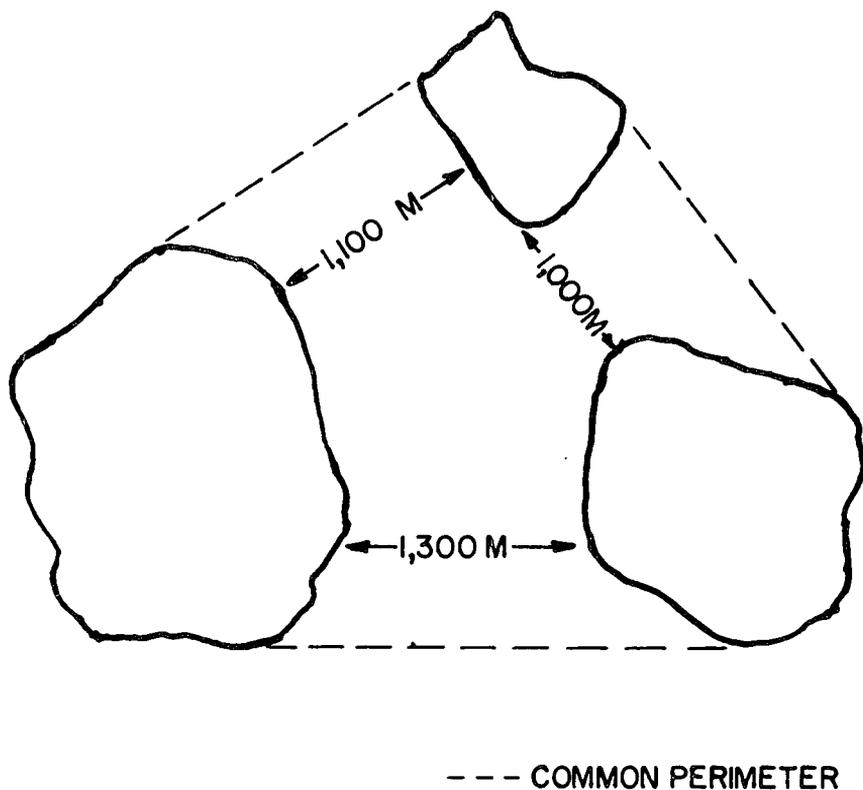


Figure 54. Integrated defense.

These SOP's must be put forth to the fire unit commander in a brief, concise manner to enable him to select targets properly. There are two factors to consider in the selection of targets: sectors of fire and rules for the selection of targets.

a. Sectors of Fire. The fire unit commander must know where the primary and secondary sectors are located physically on the ground. The primary sectors should be approximately equal in size with an overlap between the adjacent fire unit's primary sectors. The fire unit commander must know where to attack first to eliminate confusion and insure maximum effectiveness of the defense. The remainder of the area that is not included as primary sector will be the secondary sector of fire.

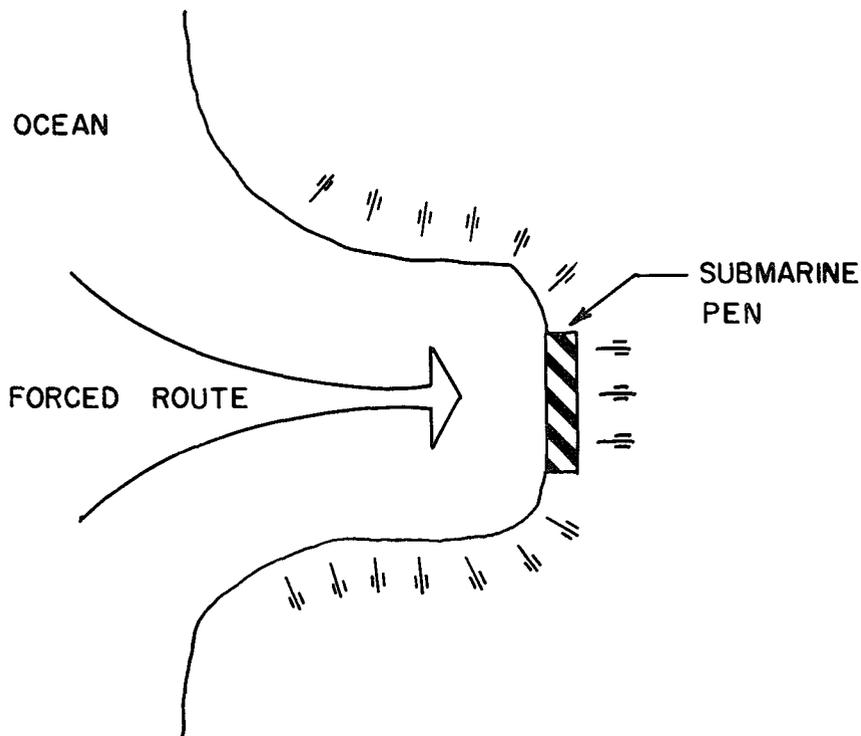


Figure 55. Forced route of approach.

b. Rules for Selection of Targets. The fire unit commander must know the rules for the selection of targets to include when to start and break off an attack. These rules should include such things as always firing on approaching targets first, insuring, when possible, that all targets are fired on and preferably by more than one weapon, from the time they are within range until the target is destroyed. Other rules are determined by the unit commander.

Section VI. WEAPON SYSTEM CHARACTERISTICS

Table VIII. Characteristics of ADA Guns

Item	120-mm	90-mm	75-mm	40-mm M42
Range:				
Vertical	15,500 yd	13,000 yd	7,200 yd	1,000 yd
Horizontal	27,162 yd	19,000 yd	15,000 yd	10,850 yd
Standard muzzle velocity	3,000 ft/sec	2,675 ft/sec	2,825 ft/sec	2,870 ft/sec
Projectile type	Separate	Fixed	Fixed	Fixed
Fuze type	MT, VT	MT, VT, PD, AP	MT, VT, PD, AP	PD, AP
Rate of fire	15 rd/min	28 rd/min	45 rd/min	240 rd/min (not sustained rate)
Tracking rate:				
Azimuth	15°/sec	20°/sec	60°/sec	40°/sec
Elevation	9°/sec	12°/sec	45°/sec	25°/sec
Weight:				
Traveling	31 tons	16 tons		25 tons
Emplaced	27 tons	13 tons	10 tons	
Crew	13 men	14 men	9 men	5 men
Radar:				
Maximum search range	M33: 120,000 yd (hor) 75,000 yd (ver)	M33: 120,000 yd (hor) 75,000 yd (ver)	24,000 yd	Mechanical computing sight
Automatic track range	99,500 yd	99,500 yd	22,000 yd	
Maximum speed of target	1,000 mph	1,000 mph	900 mph	700 mph

Note. Use conversion tables in appendix II to obtain measurements in the metric system.

APPENDIX IV
 SAMPLE FORMS AND REPORTS

- Paragraph 1. Operation Order and Operation Plan
2. Air Defense Plan Annex to Operation Order
 3. Suggested Form for Army or Theater Army Air Defense Information Bulletin
 4. Suggested Form for AD Annex to a Field Army Standing Operating Procedure
 5. Army Air Defense After Action Report
 6. Suggested Form for AD Periodic Intelligence Report

1. Operation Order and Operation Plan (FM 101-5)

 (Classification)

(Changes from oral orders, if any.)

Copy No. -----
 Issuing headquarters
 Place of issue (may be in
 code)
 Date-time group (time of
 signature)
 Message reference number

Operation order -----
 (Type, serial number, and title.)
 (Note 1.)

Reference: (Maps, charts, and relevant documents.)

Time zone: (Used throughout the order; if unnecessary, omit.)

Task organization: List here, when appropriate, the task subdivisions or tactical components that will comprise the command, together with the names and ranks of the commanders. When a task organization is not listed, this information is included in paragraph 3 or in an annex.

1. SITUATION

Such information of the general overall situation as may be essential for subordinates to understand the current situation.

a. *Enemy Forces.* Composition, disposition, location, movements, estimated strengths, identifications, and capabilities.

b. *Friendly Forces.* Pertinent information of own forces, other than those covered by the operation order, that may directly affect the action of a subordinate.

 (Classification)

c. *Attachments and Detachments.* When not shown under task organization, list here units attached to or detached from the issuing unit together with the times they are effective. When shown under task organization, list here an appropriate reference.

d. *Assumptions.* (This paragraph applicable to operation plans only.) Assumptions used by the commander as a basis for the plans; normally applicable only to higher planning echelons.

2. MISSION

A clear, concise statement of the task that is to be accomplished by the commander and its purpose.

3. EXECUTION

In the first subparagraph, give the concept of operation (note 2). In separate lettered subparagraphs, give the specific tasks of each element of the command (AD is considered as a separate element) charged with the execution of tactical duties including the organization for combat, if not already given under task organization. In the final subparagraph, titled "Coordinating instructions," give details of coordination and control measures applicable to the command as a whole and instructions applicable to two or more elements, which are necessary for coordination or the general conduct of the operation, the repetition of which in the other subparagraphs of paragraph 3 would be cumbersome.

4. ADMINISTRATION AND LOGISTICS

Instructions concerning administrative matters, including logistical arrangements, for the conduct of the operation. These instructions are frequently included in an annex or separate document to which reference should be made.

5. COMMAND AND SIGNAL

Instructions concerning signal and command including reference to a standard plan or annex—rendezvous, location and movements of commander and command posts, statement of command relationship, axis of signal communication, recognition and identification instructions, electronic policy, code words, code names, and liaison, as appropriate.

Commander

Annexes

Distribution

Authentication

Note 1. The type of operation order is usually indicated in combined or joint operations. Within a single service, the type of operation order is normally omitted. When required, a code title may also be included.

Note 2. The concept of operation includes the commander's general plan for development and phasing of the operation, the general plan for the employment of nuclear weapons and their integration with the scheme of maneuver in the overall plan of action, use of other fire support means available, instructions on preparatory fires, and designation of the unit making the main attack in those operations where appropriate. Air defense is discussed in a separate subparagraph of the concept of operation immediately following fire support. AD will not be mentioned under fire support unless it is assigned a surface mission.

(Classification)

2. Air Defense Plan Annex to Operation Order

(Classification)

Copy No. -----
Issuing headquarters
Place of issue (may be in
code)
Date-time group (time of
signature)
Message reference number

Annex ----- (air defense plan) to operation order -----
Maps, charts, or other relevant documents.

Time zone: (Used when the execution will cross time zones; if unnecessary, omit.)

1. SITUATION

State in subparagraphs *a*, *b*, and *c* so much of the general situation as is deemed essential for commanders and staffs of AD agencies to know.

a. Enemy Forces. Refer to the current intelligence publication covering the enemy situation. Refer to any particular enemy capability, such as his air and ECM capabilities, that may have a definite impact on air defense agencies. (Source: Force intelligence representative.)

b. Friendly Forces. State so much of the mission of the force as is required for coordinated action by recipients of the air defense plan. Then list the unit(s) furnishing air defense to the force. Follow with a statement of air defense units, not organic or attached, from which the force may receive incidental air defense. If AD is to use nuclear weapons in air defense of the force, so state to include number of weapons available and their yields. (Source: Air defense commander.)

c. Attachments and Detachments. List air defense units now attached or that are attached or detached by the operation order, together with the effective time and date of the attachment or detachment. (Source: Air defense commander.)

2. MISSION

State the mission of the force.

(Source: Air defense commander.)

3. EXECUTION

In separate letter subparagraphs, give a brief concept of the operation; then indicate air defense support to be rendered by available air defense agencies. Nuclear weapons available for air defense are also listed separately to indicate the importance attached to their support. List air defense agencies in alphabetical order.

a. Concept of Operation of the Force. State briefly the concept of operation of the force with emphasis on air defense. Include priorities for air defense of various elements of the force and critical areas and installations. List priorities separately for air, ADA, and naval air defense weapons. (Source: G3 or air defense commander.)

(Classification)

b. *Air Support for Air Defense.*

(1) *General.*

- (a) General information on air support for air defense including number of fighters available to the force for air defense.
- (b) Commander's desires on use of such air support, other than that specifically allocated, as may become available.

(2) *Allocations for air defense.*

- (a) By higher headquarters (and not further allocated to subordinate units).
- (b) To subordinate units (air support, or air control agencies such as forward air controllers (FAC) and air control teams (ACT)).

(3) *Miscellaneous.* Miscellaneous coordinating instructions and information concerning air support for air defense when such are not covered by standing operating procedure (SOP), or constitute a change to the standing operating procedure. The last item is a reference to the air plan for air defense.

(Source: G3 air, air liaison officer.)

c. *AD Support.* This subparagraph contains information for, and instructions to, AD units organic, attached, or under the operational control of the air defense command for the force.

- (1) *General.* Give information of the echelons of AD that will support the operation.
- (2) *Organization for combat.* Give organization for combat of air defense units organic or attached to the command. Missions must be assigned to each.
- (3) *Miscellaneous.* Give miscellaneous coordinating instructions and information for AD units, such as instructions on coordination of fires and position areas and primary zones of fire (usually reference to an appendix).

(Source: AD operations representative.)

d. *Nuclear Fires for Air Defense* (when applicable). This subparagraph is similar to the air support subparagraph, giving the general plan of employment and, if appropriate, allocations of units and weapons. The last item, titled "Miscellaneous," is a reference to the nuclear fire plan for air defense. (Source: G3, AD operations representative, and ALO.)

e. *Naval Support for Air Defense* (when applicable). This subparagraph is similar to the air support subparagraph, giving general information, allocation of air defense support from higher headquarters, plus suballocations of air defense support and of control personnel to lower echelons. These are followed by miscellaneous instructions. The last item under "Miscellaneous" is a reference to the naval air defense plan.

(Source: Naval anti-air-warfare officer.)

f. *Coordinating Instructions.* This subparagraph is the last in paragraph 3. Its actual letter designation depends on the number of air defense agencies available.

- (1) It contains instructions applicable to two or more air defense agencies such as procedures for coordinating aircraft flying in the defended area, restrictions on firing by ground or naval weapons while friendly aircraft are conducting air strikes, procedures for coordinating passage through the defended area, and the time that air defense plans must be submitted to the agency responsible for air defense coordination.
- (2) Miscellaneous troop safety instructions such as those on permissible exposure to radiation, protection during nuclear strikes, and the fact that nuclear weapons may be used for air defense at any time and without warning to friendly forces.
- (3) Items of general interest to all units such as the location of the restricted areas may be included.
(Source: G3, G3 air, air defense commander, and FSC.)

4. ADMINISTRATION AND LOGISTICS

- a. Refer to the current administrative order.
- b. List any special administrative instructions applicable to this operation and of concern to air defense agencies, such as a directive to dump ammunition on position in excess of basic load.
- c. State any items that are of interest to air defense agencies, require special emphasis, or have changed since the administrative order was published. These items may include the location of the force ammunition office(s) and appropriate available supply rates.
(Source: G3, G4, and AD operations representative.)

5. COMMAND AND SIGNAL

- a. *Signal.* Refer to the current signal annex and index to the signal operations instructions (SOI), if appropriate.
 - b. *Command.* Location of the agency(s) responsible for air defense coordination must be stated if other than as prescribed by SOP. Their locations may be shown, if desired, even when located as per SOP.
(Source: G3, AD operations representative, or units.)
- Instructions on acknowledgment.

FOR THE COMMANDER (if applicable):

Signature (or typed name of commanding general or chief of staff)

3. Suggested Form for Army or Theater Army Air Defense Information Bulletin

(Classification)

Headquarters
Place
Time and date

Air Defense Information Bulletin No. -----

TABLE OF CONTENTS. The title of each article, paragraph number, page number, and security classification is listed.

INTRODUCTION. Any pertinent remarks desired by the air defense commander (officer).

Section I. AIR DEFENSE PERSONNEL AND ORGANIZATION

Articles concerning personnel and organization are included in this section, for example:

1. New arrivals.
2. Lists of staff members and commanders of units.
3. Changes in tables of organization and equipment.
4. Any other personnel or organizational information.

Section II. OPERATIONAL PROCEDURE

Examples of appropriate articles are:

1. Any changes in air defense doctrine.
2. Uses of various types of photographs.
3. Employment of defense acquisition radars.
4. Lessons learned in previous campaigns.
5. Various methods of attack of targets as learned by experience.
6. Meteorological data.
7. Successful improvisations.
8. Other articles of operational interest.

Section III. INTELLIGENCE

Articles of intelligence activities such as—

1. Notes on prisoner-of-war interrogation.
2. Enemy measures against friendly methods of air defense.
3. Enemy methods of air attack.
4. Enemy employment of nuclear weapons.
5. Enemy tactical ruses.
6. Comparison of hostile and friendly air defense methods and equipment.
7. Enemy organization.
8. Enemy counterintelligence measures.
9. Enemy ECM activity.
10. Other articles of an intelligence nature.

(Classification)

(Classification)

Section IV. MATERIEL, SUPPLY, AND EQUIPMENT

The following are examples of such articles:

1. Test firing against enemy materiel.
2. Characteristics of new weapons and fuzes.
3. Comparative air defense effectiveness for various weapons.
4. Ammunition expenditures.
5. Other articles of interest pertaining to materiel and ammunition.

Section V. MISCELLANEOUS ARTICLES OF GENERAL INTEREST

Examples of these articles are:

1. Extracts of lessons learned in other theaters.
2. Operations of particular units.
3. Other articles of general interest.

Note. Charts, photographs, or illustrations desired or necessary for proper understanding of any articles are included.

Signature

Annexes
Distribution
Authentication

(Classification)

4. Suggested Form for AD Annex to a Field Army Standing Operating Procedure

(Classification)

Note. The SOP is published in the form that is most effective for the command. Regardless of form, the SOP is published by authority of the commander and carries the same weight as orders and instructions. Although an SOP is based on the several field manuals, it does not repeat material specifically treated in the manuals.

Issuing headquarters
Location
Date of issue

Annex B (----- Army AD SOP) to SOP, ----- Army

Section I. GENERAL

1. Reference: SOP ----- Army.
2. Applicability: AD with ----- Army and Corps.
3. Purpose: This SOP standardizes normal procedures; it applies unless otherwise prescribed.
4. Unit procedure: Subunits issue SOP to conform.
5. Definitions (when required):
 - a.
 - b.
 - c.

(Classification)

Section II. PERSONNEL AND ADMINISTRATION

(As a matter of convenience for subordinate units, extracts from ----- Army SOP relative to replacements, decorations, awards, leaves, promotions, reports, morale activities, and other pertinent subjects might be listed.)

Section III. INTELLIGENCE

6. Condition of Air Defense WARNING.

7. Reports.

a. *After Action* (DA Form 44-1, see par. 5 below).

b. *Periodic Intelligence Report* (par. 6 below).

c. *Tactical Nuclear Weapon* (extracted from ----- Army SOP for emphasis).

(1) By fastest practicable means, information indicating enemy capability of tactical employment of nuclear weapons:

(a) Withdrawal of enemy forward area units.

(b) Security detachment protecting movement of materiel.

(c) Location of enemy weapons capable of delivering nuclear missiles, projectiles, or bombs.

(d) Enemy training in nuclear warfare.

(2) Report radiation activity detected immediately and later by isointensity chart.

Section IV. OPERATIONS

8. Air Defense Effectiveness Capabilities.

a. *ADA in Division Zone of Operations.*

(1) Report to ADA group attached to corps the location of all fire units.

(2) Follow initial report with an overlay of effectiveness capabilities indicating:

(a) Grid reference of each fire unit.

(b) Minimum and maximum slant range and altitude limits of each fire unit.

(c) Areas in which specific fire units cannot fire.

b. *ADA in Corps Zone of Operations.*

(1) Report immediately through channels the location of all fire units and AADCP.

(2) Follow initial report with an overlay of effectiveness capabilities of all fire units to include information required in a(2) above.

(3) Safe burst altitudes overlay through group to brigade as soon as practicable.

c. *ADA in Army Zone of Operations.* Report all information as required in a and b above.

9. Location of Defended Units.

a. ADA in Division Zone of Operations. Disseminate all changes in location of defended units in the defended areas, including planned operations involving displacement to ADA group and subordinate and adjacent units.

b. ADA in Corps Zone of Operations. Report and disseminate all changes in air corridors to higher, subordinate, and adjacent headquarters in addition to information required in *a* above.

c. ADA in Army Zone of Operations. Provisions of *b* above apply.

10. Safe Burst Altitudes.

a. Unit SOP's will reflect theater commander's decision.

b. All missile fire units capable of firing nuclear warheads will have a current overlay depicting the safe altitudes in its zone of effectiveness.

11. Displacement. With the exception of a tactical necessity, all units under operational control of ADA group and brigade will not displace without prior clearance and coordination with this headquarters.

12. AD Aviation.

a. Airfield:

(1) Aircraft will be stationed at airfields assigned by unit commander.

(2) When unit airfields are impractical, the nearest army aviation airfield will be utilized.

b. Operation. Regardless of where the aircraft are stationed, unit commander will retain operational control of aircraft.

c. Communication. SOL, SSI applies.

13. Rules for Engagement. Unit SOP's will reflect theater commander's decision.

14. Condition of Air Defense Warning. The theater AD commander is responsible for determining the condition of the air defense warning. Warning will be announced to all AADCP's.

15. AD States of Alert.

a. Battle Stations. Minimum personnel required to deliver continuous effective fire. Equipment ready for immediate operation.

b. Standby. Personnel and equipment ready to assume battle stations within _____ minutes*.

c. All Clear. Minimum personnel ready to assume battle stations, and equipment operational within _____ minutes*. Fire control equipment and power plant must be warmed up periodically.

16. Surface-to-Surface Fires. Air defense may be given a surface mission during a specific period such as a nuclear target of opportunity, in which case the unit must be capable of reverting to AD mission on short notice.

a. Fire unit establishes liaison with appropriate artillery headquarters.

b. Fire unit establishes communication as directed.

* Time prescribed by AADC.

(Classification)

Section V. LOGISTICS

17. General. Conform to para. -----, Logistics SOP; Army.
18. Ammunition. ADA group inform subordinate units of available supply rate.
19. Evacuation. Units directed to nearest clearance station.
20. Services. Subordinate units inform ADA group of service request.
21. Maintenance. Conform to para. -----, Logistics SOP; Army.
22. Reports.
 - a. Report ammunition in excess of basic load every 24 hours as of 2400 on DA Form 581.
 - b. Equipment shortage report.
 - c. Unit equipment status report every 24 hours as of 2400.

Section VI. COMMAND

23. Command Posts. Battalions and fire units report movement and location to ADA group. ADA group report to ADA brigade.
24. Communication.
 - a. *General.* Conform to Army SOI and SSI. All communication officers extract information as necessary and as authorized.
 - b. *Radio Nets.* Organic radio nets as described in FM 44-series.
 - c. *Wire System.*
 - (1) Area communication system provides facilities to ADA battery, battalion, group, and brigade except forward area weapons.
 - (2) Forward area weapons will install wire circuits to nearest area communication center when practical.
 - (3) See SOI and SSI for circuit requirements and priorities.
 - d. *Security.*
 - (1) Evidence of wiretapping or cutting will be reported immediately.
 - (2) Evidence of radio transmission jamming will be reported immediately.
 - (3) Loss of SOI, SSI, or extracts thereof, will be reported immediately.

(Signature)

Authentication

(Classification)

5. Army Air Defense After Action Report

Preparation Instructions for DA Form 44-1

1. INITIATION.

To be initiated at ADA battery level for any engagement with the enemy involving the expenditure of one or more missiles.

2. DISPOSITION.

The form is prepared in triplicate:

- a. Forward one copy to the Commandant, United States Army Air Defense School, Fort Bliss, Texas, for analysis and evaluation by automatic data processing methods.
- b. Forward one copy through command channels to area air defense headquarters level for consolidation into statistical data of operations.
- c. Retain one copy in battery file.

3. PREPARATION.

The following instructions refer to specific numbered items. In any situation where circumstances cannot be adequately described on the form, a sketch or diagram should be attached to the form.

Item 1. Theater of Operations; e.g., Europe.

Item 2. Unit to Which Attached or Assigned; e.g., 7th US Army.

Item 3. Date of Action; e.g., 1 Oct 61.

Item 4. Fire Unit Identification; e.g., C Btry, 5th Bn, 6th Arty.

Item 5. Fire Unit GEOREF Coordinates; e.g., NKHK 253355.

Item 6. System Number; e.g., 1183.

Item 7. Name and/or Description of Defended Area; e.g., Nuclear Weapons Depot.

Item 8. Location of Defended Area; e.g., Vicinity of Ekinburg, Germany.

Item 9. Missile and Target Information:

a. Type of Missile; e.g., HERCULES.

b. Serial Number; e.g., 12138.

c. Warhead Type; e.g., T45.

d. Number and Type of Targets; e.g., 1-B. (F—Fighter, B—Bomber, BM—Ballistic Missile, A—Aerodynamically Supported Missile, R—Rocket, H—Helicopter, D—Drone. If SS mission, describe in remarks.)

e. Speed of Target; e.g., 500 knots. (Specify unit of measurement.)

f. Time Acquired; e.g., 1200Z.

g. Course; e.g., Incoming (Incoming, outgoing, crossing).

Item 10. Engagement Information:

a. Time of Firing; e.g., 1205Z.

b. Method of Firing; e.g., SA HAWK: Battery Control Central (BCC) or Assault Fire Command Console (AFCC). NIKE: Surface-to-Air (SA), Low Altitude (LA), or Surface-to-Surface (SS).

c. *Burst Range; e.g., 48,000 yards. (Specify unit of measurement.)

d. *Burst Altitude; e.g., 11,200 feet. (Specify unit of measurement.)

e. *Time of Flight; e.g., 58 (seconds).

f. *Hit Proximity; e.g., X-10 yards.

Y-15 yards.

H-12 yards.

R-23.5 yards.

(Specify unit of measurement of each. Hit proximity defines the location of the burst relative to the target. The X coordinate is the horizontal distance of the burst from the target, measured perpendicular to the battery-target

See footnotes at end of instructions.

(Classification)

line. A burst to the right of the battery-target line has a plus value and a burst to the left, a minus value. The Y coordinate is the horizontal distance of the burst from the target, measured parallel to the battery-target line. A burst beyond the target has a plus value and a burst short of the target, a minus value. The H coordinate is the vertical distance of the burst from the horizontal plane of the target. A burst above the target has a plus value and a burst below the target, a minus value. R is the radial distance of the burst from the target.)

g. Number of Targets Destroyed—per each missile fired; e.g., 1.

Item 11. Remarks:

Appropriate remarks must be made if no targets were destroyed, or if needed to clarify the report add sketch and descriptive text on additional sheet. If ECM is encountered, identify type; e.g., noise, sweep chaff—and amount of degradation of operations; e.g., loss of lock, delay of transfer.

4. CLASSIFICATION.

Completed report will be classified in accordance with AR 380-5 or AR 380-150.

* NIKE: If this information is not available at the fire unit, two copies of the report should be forwarded to the next higher headquarters with the tape, if any, made of the engagement. This information should then be recorded and forwarded as indicated under disposition.

HAWK: Record this information if available and indicate source from which obtained (telemetry, estimate, etc.).

Note. ECM condition can be indicated in item 11, Remarks, as 0,1, 2, or 3.

6. Suggested Form for AD Periodic Intelligence Report

(Classification)

Issuing unit:

Place:

Date and hour of issue:

PERIODIC INTELLIGENCE REPORT NO. -----

Period covered: (From) (To)

Maps: (Those needed for an understanding of the report.)

1. ENEMY SITUATION AT END OF PERIOD

a. *Enemy Forward Combat Elements* (or nearest elements). Location and nature.

b. *Location and Number of Enemy Airfields, Missile Launching Sites, Aircraft Interceptor Control Posts, Etc.*

c. *Enemy Aircraft and Missiles.*

(1) Number of aircraft and missile units available for striking the defended area.

(2) Estimated combat efficiency (strength, degree of training, morale, and other pertinent factors, such as has unit undergone nuclear attack recently? Can casualties be expected from residual radiation effects)?

d. *Targets Suitable for Surface-to-Surface Missions.*

(Classification)

(Classification)**2. ENEMY OPERATIONS DURING PERIOD***a. General Summary.**b. Aircraft, Missile, or ECM Operations.*

(1) Reports of attacks to include time, place, effectiveness, and quantity.

Mention types of targets being attacked by enemy.

(2) Shifts in missile launching sites or airfields.

(3) Other pertinent actions.

c. Operation of Component Elements.

(1) Air defense artillery.

(2) Armor.

(3) Aviation.

(4) Engineers.

(5) Field artillery.

(6) Infantry.

(7) Other elements.

d. Miscellaneous. Such enemy activities, movements, or changes since last report as are not conveniently included in *b* and *c* above.**3. OTHER INTELLIGENCE FACTORS***a. Estimate Enemy Casualties Caused by Air Defense Operations.**b. Morale.**c. Supply and Equipment.**d. Terrain (as it affects movement).**e. Enemy's Probable Knowledge of Our Air Defense Situation.**f. Enemy Counterintelligence Measures.**g. Weather.**h. Any Enemy Intelligence Not Specifically Covered by Headings of This Report.***4. COUNTERINTELLIGENCE**

Brief résumé of counterintelligence situation derived from air defense sources.

*a. Espionage.**b. Sabotage.**c. Propaganda and Rumors.**d. Miscellaneous.***5. ENEMY CAPABILITIES**

A discussion of the lines of action open to the enemy that will affect air defense. For each enemy capability, the effect of time, terrain, ammunition, supply, and other factors will be evaluated. The earliest estimated time at which the enemy can put each into effect should be stated. When applicable, the possible result of the adoption by the enemy of any capability should be included.

Signature

Annexes

Distribution

Authentication

(Classification)

APPENDIX V
TYPICAL AD ORGANIZATION CHARTS

Section I. Air Defense Organizations, CONUS

- Paragraph 1. Headquarters and Headquarters Battery, Air Defense Artillery Brigade, CONUS.
2. Headquarters and Headquarters Battery, Air Defense Artillery Group, CONUS.
 3. Air Defense Artillery Operations Detachment, BIRDIE, CONUS.
 4. Air Defense Artillery Missile Battalion, NIKE-AJAX, CONUS.
 5. Air Defense Artillery Missile Battalion, NIKE-HERCULES, CONUS.
 6. Headquarters Detachment, Air Defense Artillery Missile Battalion, Universal, NIKE, CONUS.
 7. Air Defense Artillery Missile Battalion, HAWK, CONUS.

Section II. Air Defense Organizations, Field Army

- Paragraph 8. Headquarters and Headquarters Battery, Air Defense Artillery Brigade.
9. Headquarters and Headquarters Battery, Air Defense Artillery Group.
 10. Air Defense Artillery Missile Battalion, NIKE-AJAX.
 11. Air Defense Artillery Missile Battalion, NIKE-HERCULES.
 12. Air Defense Artillery Missile Battalion, HAWK.
 13. Air Defense Artillery Automatic Weapons Battalion (SP).

Section I. AIR DEFENSE ORGANIZATIONS, CONUS
 1. Headquarters and Headquarters Battery, Air Defense Artillery Brigade, CONUS

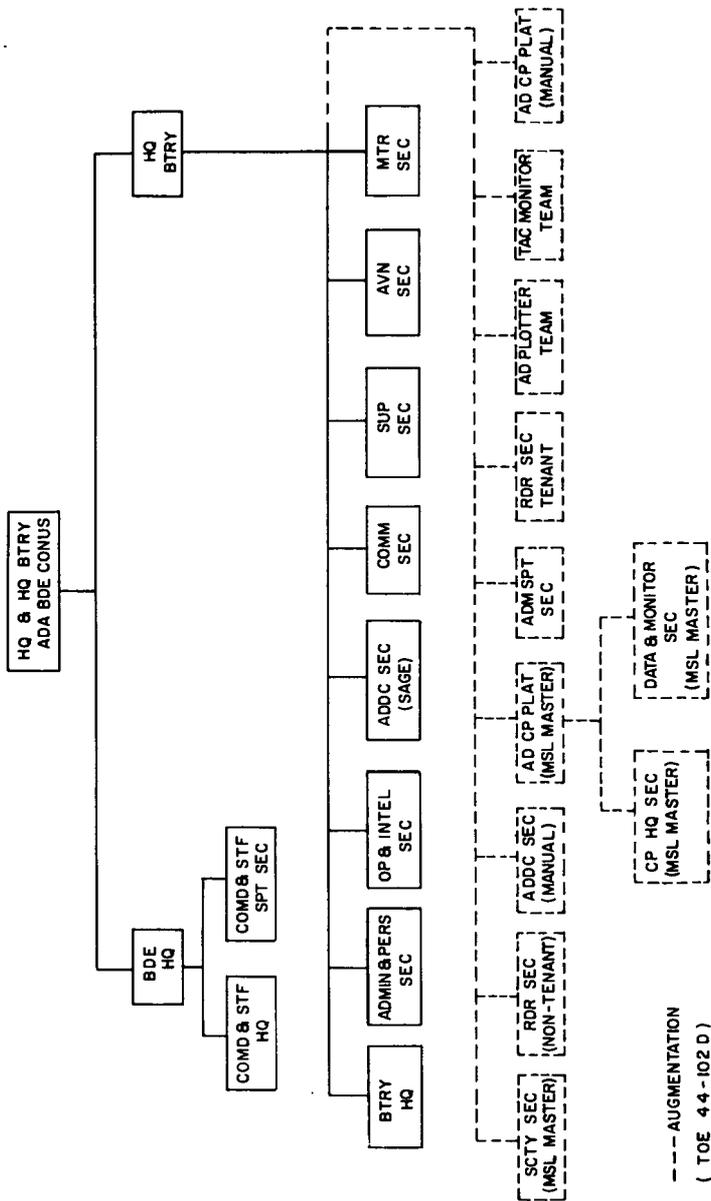


Figure 56. Headquarters and headquarters battery, air defense artillery brigade, CONUS.

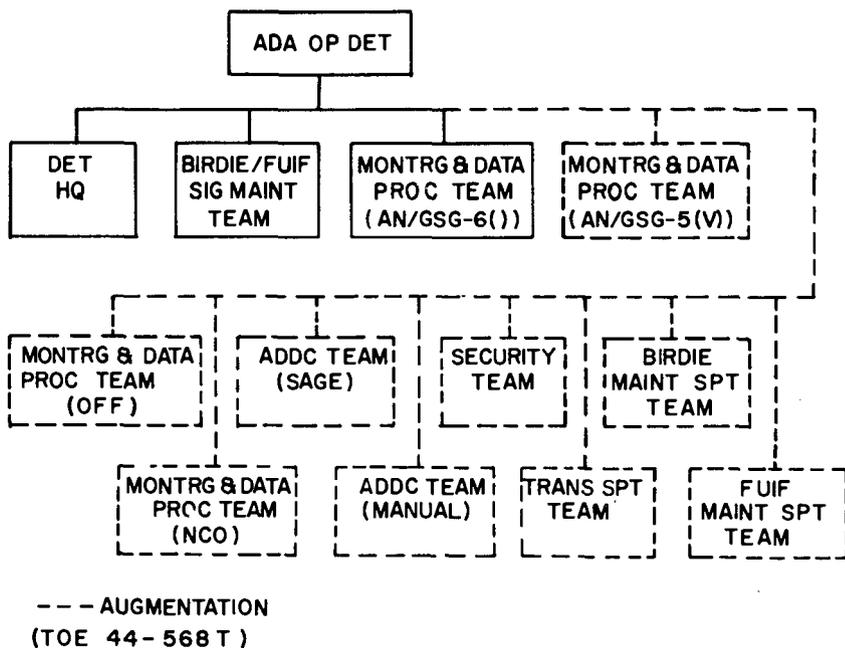
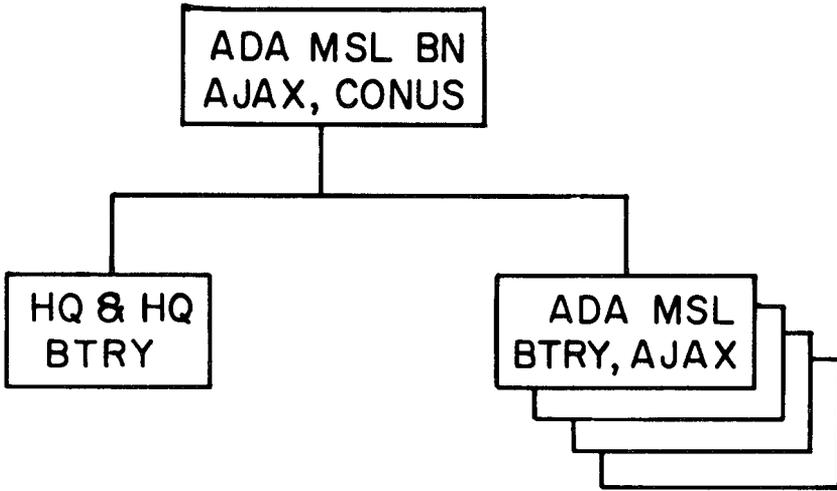
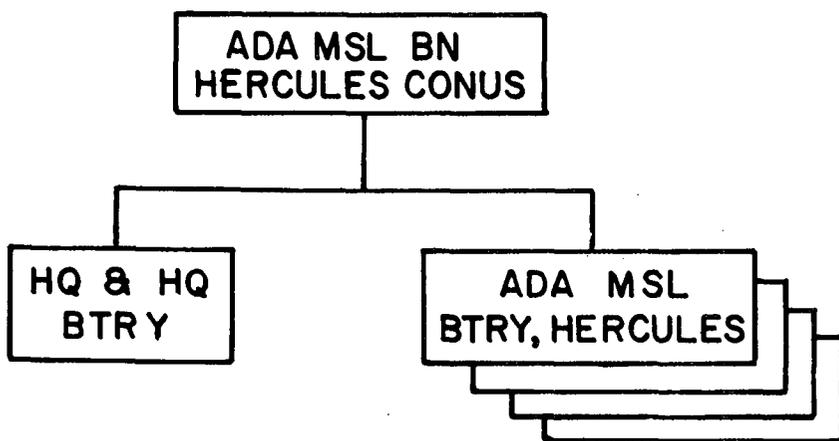


Figure 58. Air defense artillery operations detachments, BIRDIE, CONUS.



(TOE 44-445 E)

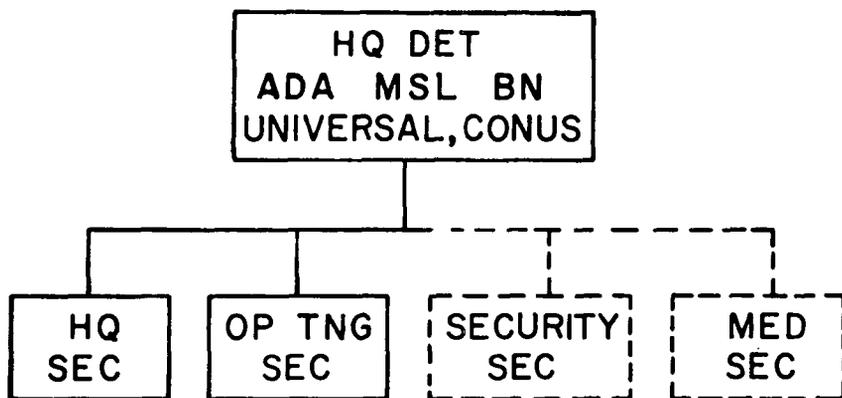
Figure 59. Air defense artillery missile battalion, NIKE-AJAX, CONUS.



(TOE 44- 545 D)

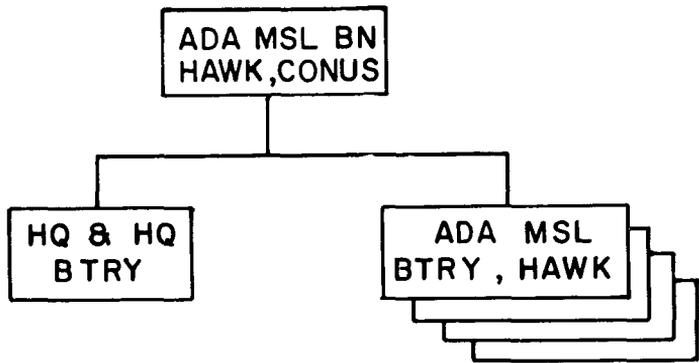
*Figure 60. Air defense artillery missile battalion,
NIKE-HERCULES, CONUS.*

6. Headquarters Detachment, Air Defense Artillery Missile Battalion, Universal, NIKE, CONUS



--- AUGMENTATION
(TOE 44-166 D)

Figure 61. Headquarters detachment, air defense artillery missile battalion, universal, NIKE, CONUS.



(TOE 44-245 T)

Figure 62. Air defense artillery missile battalion, HAWK, CONUS.

8. Headquarters and Headquarters Battery, Air Defense Artillery Brigade

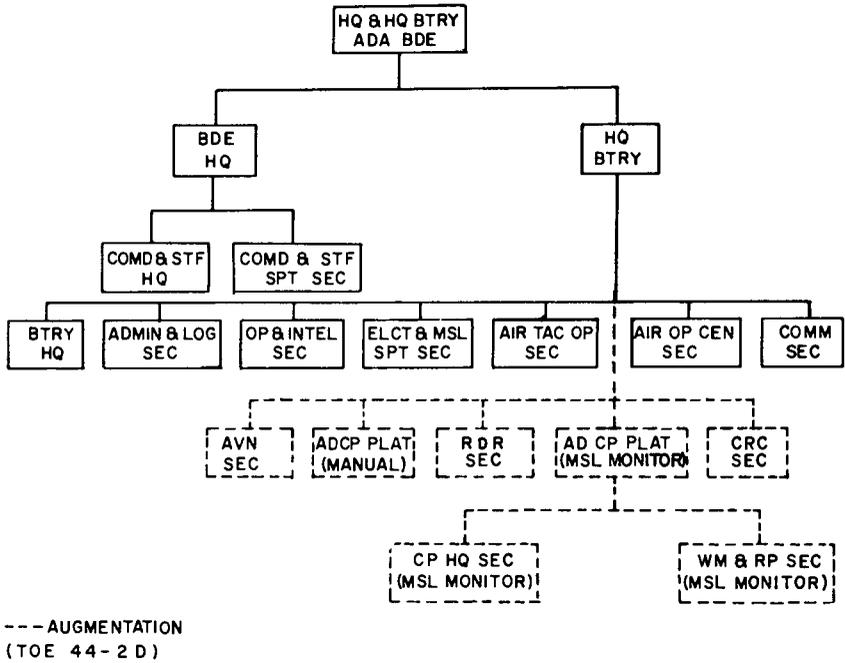
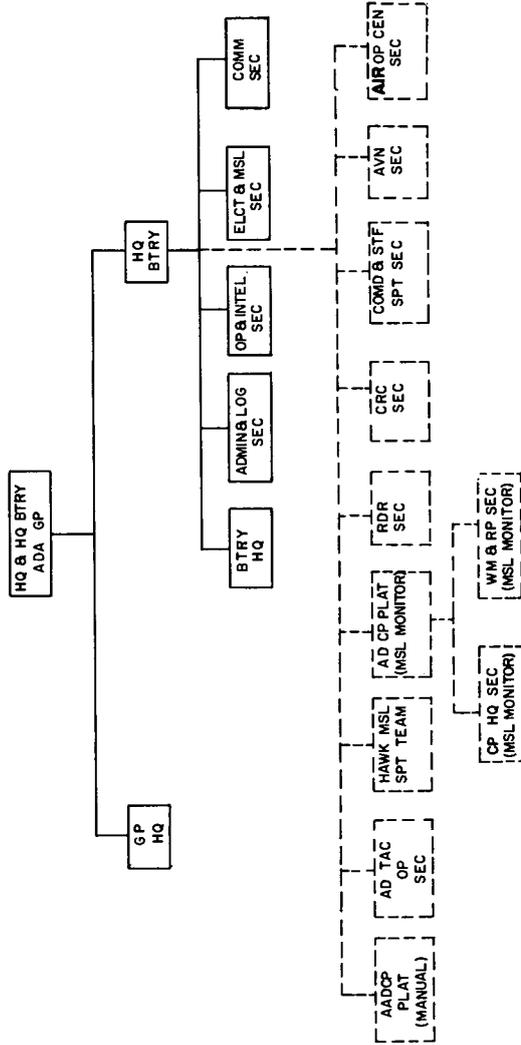


Figure 63. Headquarters and headquarters battery, air defense artillery brigade.

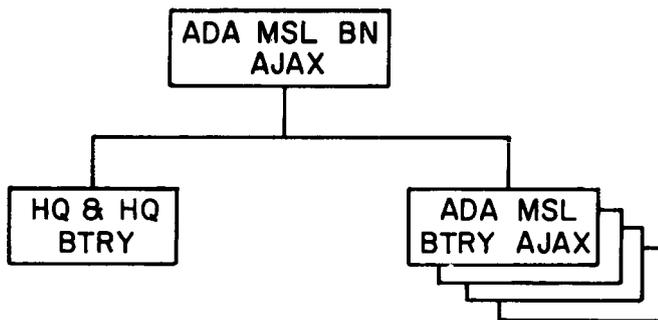
9. Headquarters and Headquarters Battery, Air Defense Artillery Group



---AUGMENTATION
(TOE 44-12 D)

Figure 64. Headquarters and headquarters battery, air defense artillery group.

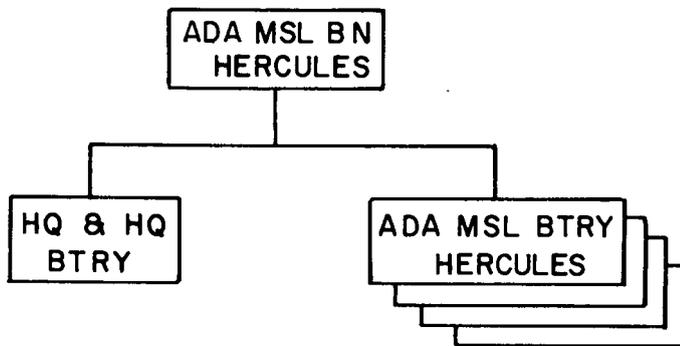
10. Air Defense Artillery Missile Battalion, NIKE-AJAX



(TOE 44-435E)

Figure 65. Air defense artillery missile battalion, NIKE-AJAX.

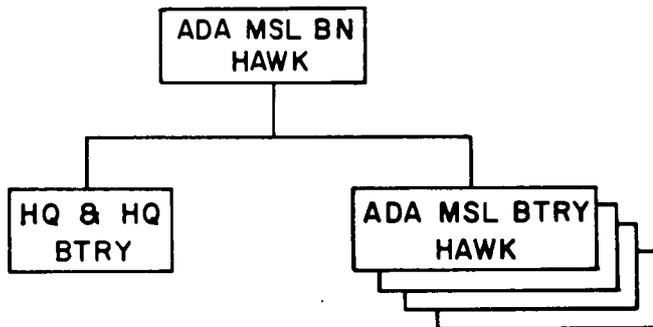
11. Air Defense Artillery Missile Battalion, NIKE-HERCULES



(TOE 44-535 T)

Figure 66. Air defense artillery missile battalion, NIKE-HERCULES

12. Air Defense Artillery Missile Battalion, HAWK



(TOE 44 - 235 T)

Figure 67. Air defense artillery missile battalion, HAWK.

13. Air Defense Artillery Automatic Weapons Battalion (SP)

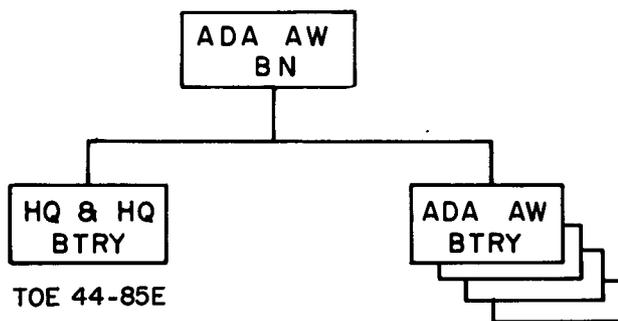


Figure 68. Air defense artillery automatic weapons battalion (SP).

GLOSSARY

Section I. ABBREVIATIONS

Standard abbreviations are contained in AR 320-50.

AAE	Army aviation element
AATRI	Army air traffic regulation and identification
ADAD	Air defense artillery director (SAGE)
ADE	Air defense element
AJD	Antijam display
ASA	Army security agency
ATABE	Automatic target and battery evaluation
BFDC	Battalion fire distribution center
BIRDIE	Battery integration radar display equipment
BMEWS	Ballistic missile early warning system
BTE	Battery terminal equipment
CBRE	Chemical, biological, and radiological element
CEE	Communication-electronics element
CRP	Control and reporting post
DC	Direction center
ENGRE	Engineer element
EPS	Electrical power supply
EW/RP	Early warning/reporting post
FATOC	Field army tactical operation center
FCC	Flight coordination center
FDC	Fire distribution center
FDS	Fire distribution system
FSE	Fire support element
FUA	Fire unit analyzer
GFDC	Group fire distribution center
GF/RP	Gap filler/reporting post
GR	Gun ring
HIPAR	High-power acquisition radar
INH	Improved NIKE-HERCULES
IRBM	Intermediate range ballistic missile
LOPAR	Low-power acquisition radar

NCC	NORAD control center
NRCC	NORAD region combat center
NSDC	NORAD sector direction center
OR	Operational reliability
PFT	Planning factors table
PKSS	Single-shot kill probability (SSKP)
RDPE	Radar data processing equipment
SPACETRACK	National Space Surveillance Control Center
SPADATS	Space detection and tracking system
SPASUR	Satellite detection system
TAADC	Theater Army Air Defense Command
TAFADC	Theater Air Force Air Defense Command
TASE	Tactical air support element
TJADC	Theater Joint Air Defense Command
VA	Vital area

Section II. DEFINITIONS

Standard definitions are contained in AR 320-5.

Adjacent AADCP—AADCP that is geographically proximate but not necessarily on the same level in the chain of command.

Aerial pickets—Aircraft disposed around a position, area, or formation, primarily to detect, report, and track approaching enemy aircraft, and to control intercepts (*see* airborne early warning and control).

Airborne early warning and control—Air surveillance and control provided by long-range reconnaissance aircraft or airship equipped with search and height-finding radar and communications equipment for controlling weapons (*see* air pickets).

Air command—For operational purposes, usually two or more air forces.

Air defense—All measures designed to nullify or reduce the effectiveness of the attack by hostile aircraft or guided missiles after they are airborne.

ACTIVE—Direct defensive action taken to destroy or reduce the effectiveness of an enemy air attack. It includes such measures as the use of fighter aircraft, antiaircraft artillery, electronic countermeasures, and SAM.

PASSIVE—All measures, other than active defense, taken to minimize the effects of hostile air action. These include

the use of cover, concealment, camouflage, dispersion, and protective construction.

Air defense action area—An area and the airspace above it within which friendly aircraft are normally given precedence in operations except under specified conditions.

Air defense area—(Overseas) A specifically defined airspace for which air defense must be planned and provided. (CONUS) Airspace of defined dimensions designated by the appropriate agency within which the ready control of aircraft is required in the interest of national security during an air defense emergency.

Air defense artillery director—An Army officer assigned to duty in a direction center (SAGE) and responsible for coordinating Army air defense action against selected airborne objects.

Air defense emergency—Any state of events that indicates to CINC, continental AD command, or higher authority, that hostile air action is in progress or is imminent or is sufficiently probable as to require, in the interest of national security, the implementation of any portion of approved plans and agreements for the defense of the U.S. Air defense emergency provides the legal authority for implementation of approved plans and agreements and, once established, will remain in effect for the duration of hostilities or until terminated officially by appropriate authority. Within the legal framework of air defense emergency, imminence of attack will be specified by degrees of warning.

Air defense warning red—Attack by hostile aircraft is imminent or is taking place. (This means that hostile aircraft are within an air defense sector or are in the immediate vicinity of an air defense sector with high probability of entering the sector.)

Air defense warning white—Attack by hostile aircraft is improbable. May be called either before or after air defense warning yellow or red. (The initial declaration of air defense emergency will automatically establish a condition of air defense warning white for purposes of security control of air traffic.)

Air defense warning yellow—Attack by hostile aircraft is probable. (This means that hostile aircraft are en route toward an air defense sector or unknown aircraft suspected to be hostile are en route toward or are within an air defense sector.)

Alternate AADCP—An AADCP subordinate to the primary AADCP that will assume its functions in the event that the primary AADCP is destroyed or rendered inoperable.

Area of operations—A term used to designate that portion of an area of war necessary for military operations, either offensive or defensive, pursuant to an assigned mission, and for the administration incident to such military operations.

Area of responsibility—A defined area in which responsibility is specifically assigned for development and maintenance of installations, control of personnel, or conduct of tactical operations.

Attack threat—The estimated type, number, speed, altitude, weapons, and information of enemy aircraft or guided missiles that a defense must repel.

Battery control area—That area required to emplace the ground guidance control equipment.

Combat air patrol—An aircraft patrol provided over an objective area, over the force protected, over the critical area of a combat zone, or over an air defense area, for the purpose of intercepting and destroying hostile aircraft before they reach their target.

Complex defense—A complex defense results from the integration of three or more adjacent defenses.

Danger area—A specified area within, below, or over which there may exist activities constituting potential danger to aircraft flying over it.

Dead time—The elapsed time between the detonation of one missile and launch of the succeeding round by the same fire unit at the same target (NIKE-AJAX or NIKE-HERCULES) or the elapsed time between firing the first and second missiles of a pair (HAWK).

Direction-of-attack line—A line drawn on a map or overlay representing an assumed direction of attack by the enemy.

Direction-of-flight line—A line drawn on a burst locator representing the horizontal projection of the assumed flight path of an enemy target.

Isodamage contour—An imaginary line connecting points of equal damage or casualties that would result from the detonation of a specified weapon. Damage contours are usually expressed in millions of dollars of industrial damage and population mortality contours in thousands of deaths.

Isolated defense—Isolated vital areas are defenses separated from each other by distances that preclude integration of adjacent defenses.

Joint staff—1. The staff of a commander of a unified or specified command, or of a joint task force, that includes members from the several services comprising the force. These members should be assigned in such a manner as to insure that the commander understands the tactics, techniques, capabilities, needs, and limitations of the component parts of the force. Positions on the staff should be divided so that service representation and influence generally reflect the service composition of the force.

2. The staff of the Joint Chiefs of Staff as provided for under the National Security Act of 1947, as amended.

Joint zone (air, land, or sea)—An area established for the purpose of permitting friendly surface, air, and subsurface forces to operate simultaneously.

Kill contour—An imaginary line connecting the earliest points for a given assurance at which the last target in a specific threat will be destroyed.

NORAD Combat Operations Center (COC)—The command post for CINCNORAD that operates as a data-gathering and storage, situation display, and command communication facility.

NORAD Control Center (NCC)—The facility from which the NCC commander coordinates and supervises surveillance and identification activities and conducts the air battle within an assigned area of responsibility (subordinate to a region or sector).

NORAD Region Combat Center (NRCC)—The command post of the NORAD region commander established to supervise and coordinate the combat effort of all air defense forces available to the region commander.

NORAD Sector Direction Center (NSDC)—The command post of the NORAD sector commander from which he supervises, coordinates, and directs defense forces made available to him. These facilities use SAGE in most of CONUS.

Vital area (CONUS)—A certain concentration of population or industry, or a military establishment that must be defended against air attack to retain its national defense production and retaliatory capabilities.

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BY ORDER OF THE SECRETARY OF THE ARMY:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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