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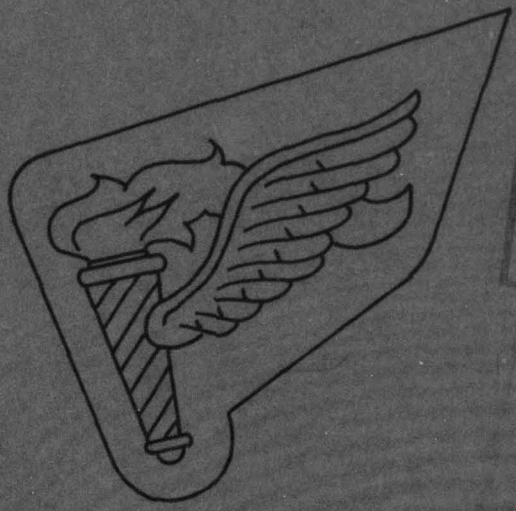
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PATHFINDER HANDBOOK

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FOR THE CHIEF:

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This handbook has been prepared by the Pathfinder Committee, Airborne Department, United States Army Infantry School, and is approved for resident and extension course use by the United States Army Infantry School only. It reflects the current position of the School and conforms to printed Department of the Army doctrine as closely as possible.

This handbook consists of 7 Chapters and 8 Appendices, the title of each is indicated on the right hand margin of this page. To facilitate use of this handbook, a tabbing system is indicated on this page related to each Chapter and Appendix.

CHAPTER	TITLE
1	MISSION, CAPABILITIES, EQUIPMENT, ORGANIZATION, AND LIMITATIONS
2	OPERATIONS
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4	HELICOPTER LANDING ZONES
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CHAPTER 1

INTRODUCTION

1. PURPOSE AND SCOPE.

a. This ~~handbook~~ manual is designed to provide ~~students of the United States Army Infantry School~~ a ready reference concerning the organization, training, and employment of TOE pathfinders units and unit terminal guidance personnel.

b. The material contained in this ~~handbook~~ manual is applicable to nuclear and non-nuclear warfare.

c. This handbook outlines the procedures used by pathfinder units during various types of operations. These procedures may also be used by unit terminal guidance personnel. The fact that ground units do not have supporting TOE pathfinder units does not affect the basic guidance procedure.

d. This handbook must be used in conjunction with FM 1-5, 1-105, 7-11, 7-15, 7-20, 7-30, 21-60, 57-35, 61-100, and TT 61-100-1.

e. The tactics, techniques and procedures described herein for the conduct of various types of missions are not inflexible rules, but are guides which can be modified as varying conditions of airmobile operations require.

f. This text is approved for Resident and Extension Course instruction at the United States Army Infantry School only. It reflects the current thought of this School and conforms to printed Department of the Army doctrine as closely as possible.

g. This handbook contains a glossary of terms and definitions peculiar to airmobile and pathfinder operations and air traffic control. Users of this handbook are urged to read and refer to this glossary as an aid to understanding the text.

2. MISSION.

a. The primary mission of Army pathfinder units is to provide navigational assistance to and control of Army aircraft in areas designated by supported unit commanders.

b. Secondary missions for pathfinder units include providing limited advice and physical assistance to lifted units in the planning of airmobile operations and the preparation and positioning of personnel and loads for air movement.

3. CAPABILITIES.

a. Pathfinder units have the following capabilities:

(1) Conduct reconnaissance for and selection of landing or drop zones for Army aircraft in areas which have been selected by supported unit commanders.

(2) Move to areas of operation by foot, water or surface vehicles, aircraft or parachute.

(3) Prepare landing or drop zones to include establishing and operating visual and electronic navigational aids and removal of minor obstacles. Furnishes ground-to-air voice radio communications to aircraft for the purpose of providing information, guidance, and air traffic control within the area of operation. Through direct coordination with co-located fire supported units, pathfinders provide advisory service to aviators concerning friendly mortar and artillery fires.

(4) Assist in the assembly of air delivered troops, supplies, and equipment.

(5) Provide advice and limited physical assistance in the preparation and positioning of troops, supplies, and equipment for air movement.

(6) Conduct limited CBR monitoring or survey of designated areas.

(7) Provide limited weather observations to include wind velocity and direction, cloud cover, visibility, approximate ceiling, and density altitude.

(8) Operate, by mutual agreement, drop zones and airfields for USAF aircraft in the absence of USAF combat control teams. In this situation, it may be necessary to provide pathfinders with radios (UHF, VHF) that are compatible with Air Force aircraft.

b. Each pathfinder section is organized and equipped to establish and operate:

(1) Day or night control facilities for the simultaneous operation of four helicopter landing sites of any type. Night operation of these landing sites may be limited by the amount of lighting equipment organic or available to pathfinders. Included is the provision for one manned release point.

(2) Two day or night fixed wing airfields.

(3) Three day or night resupply or personnel drop zones.

(4) Three LOLEX zones.

4. LIMITATIONS. Organic personnel and equipment strength of pathfinder units require that employment be limited to aircraft guidance and other primary tasks. It is necessary that these units be augmented by additional personnel from a supported unit to:

a. Provide security.

b. Remove major obstacles.

c. Recover and assemble equipment and supplies.

d. Operate additional radio nets and telephones.

e. Transport items of equipment.

f. Conduct detailed CBR monitoring and survey.

5. ORGANIZATION AND ASSIGNMENT.

a. The basic pathfinder unit consists of 2 officers and 13 enlisted men. Each member of the unit is a qualified parachutist and must be cross-trained in the pathfinder duties of other unit members.

b. Pathfinder units may be organic to:

(1) Field Army or separate corps (TOE 7-168E).

(2) Divisional and separate aviation battalions possessing a troop lift capability (TOE 1-76, 1-56, and 1-256).

(3) Aviation group of the airmobile division (TOE 1-101).

c. Depending upon their location within the Army structure, a pathfinder unit may be referred to as a platoon, section or detachment.

6. EQUIPMENT.

a. General. The TOE of the pathfinder unit provides equipment essential to pathfinder operations. However, additional equipment may be required when the unit is committed to its maximum capability.

b. Navigational Aids. Naviagational aids are used to help aviators locate and identify an exact area. Electronic and visual navigational aids are the two principal types employed.

(1) Electronic aids include homing beacons, transponders, radios, and any other electronic device that assists in aircraft navigation. They have a greater range and provide more secuirty than visual navigational aids. While radio ordinarily is considered an insecure means of signaling, it is a relatively secure means in pathfinder operations because of the time required by an enemy to obtain a direction finding (DF) fix and dispatch a force to the area. However, any electronic aid may be subject to enemy jamming.

(2) Visual navigational aids are used to designate specific areas or points in landing and drop zones. They are also used in transmitting ground-to-air signals. Daytime visual navigational aids include panels, smoke, and colored jackets for signalmen. Night visual aids include light beacons, glide slope indicators, lanterns, baton flashlights, and pyrotechnics. Numerous day or night field expedient visual aids may also be used effectively. Visual navigational aids provide less security in that the majority may be seen by the enemy.

c. Communication Equipment. Organic communications equipment includes the AN/PRC-25 radio and limited wire equipment, insuring the capability of communicating with aircraft, other pathfinder elements, and supported units. A homing capability has been incorporated into the radio equipment most often encountered by pathfinders to provide additional navigational assistance.

d. Assembly Aids. Assembly aids are used to designate troop or supply assembly areas. As with navigational aids, assembly aids may be either electronic and visual. Available field expedient means may also be effectively employed.

(1) Electronic assembly aids include radios and homing devices employing a radio signal. They provide more security and usually greater range than visual assembly aids.

(2) Visual assembly aids are usually simple to employ and afford positive identification of assembly areas, but they can be seen by enemy as well as friendly troops and close coordination of their use is required to prevent misunderstandings. Visual assembly aids include panels, smoke, and armbands, for day operations and lanterns, flashlights, light beacons, and pyrotechnics for night use.

e. Miscellaneous Equipment. Miscellaneous pathfinder equipment includes vehicles, binoculars, small starlight scopes, non-electronic demolition kits, wind measuring equipment, parachutes, and CBR detection equipment.

7. TRAINING.

a. Commanders of major units to which pathfinder units are assigned are responsible for pathfinder unit training and proficiency. Pathfinder training is most beneficial when it is integrated with that of aviation and ground units.

b. Pathfinders are qualified through successful completion of the Pathfinder Course, Airborne Department, United States Army Infantry School, Fort Benning, Georgia. Unqualified personnel serving in TOE pathfinder units in the Republic of Vietnam may become qualified under the provisions of a pertinent directive published by Headquarters, United States Army, Vietnam.

c. Pathfinder unit training is carried out under the guidelines provided by ATP 7-168. In any pathfinder training program emphasis must be placed on development of individual proficiency in air traffic control procedures and a thorough understanding of supported aviation unit SOP.

d. Terminal guidance personnel in ground units are either graduates of the Pathfinder Course or of post or unit schools which follow a program of instruction similar to that of the Pathfinder Course. Additional training in pathfinder techniques for all personnel participating in or engaged in airmobile operations is outlined in Army Subject Schedule 7-50, Air Mobility Training.

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CHAPTER 2

OPERATIONS

Section I. EMPLOYMENT

8. GENERAL.

a. Pathfinders are employed however and whenever necessary to provide the required guidance and control of Army aircraft. This encompasses any phase of an airmobile operation or a ground operation requiring sustained support by Army aircraft.

b. In some situations this employment may be only on a short-term, mission basis with pathfinders being extracted from a landing site or drop zone for employment elsewhere upon completion of the major lift/drop into the area.

c. Aviation units with sufficient pathfinder resources may best support airmobile operations by attaching pathfinder elements to ground units for the duration of an operation. This may occur down to company level. During such employment, pathfinders provide air traffic control, guidance and information on an around-the-clock basis for any type airmobile movement or resupply operation conducted by or for the ground unit and supported by any aviation unit.

d. Pathfinder units are trained and equipped for the selection, improvement, marking, and control of sites, as required. Engineer elements in DS of lifted ground units may assist pathfinders in the improvement of sites. In most situations, pathfinders perform two or more of the above functions simultaneously, with priority given to rapid establishment of ground-to-air radio communications.

e. A pathfinder unit must be able to perform any of the assigned pathfinder missions with a minimum of notice and preparation.

9. SECONDARY EMPLOYMENT.

a. Pathfinder personnel and equipment normally remain assembled in the vicinity of, and in communication with, the supported unit command post except when performing pathfinder duties for subordinate units.

b. When the pathfinder unit has completed preparations to perform further missions, it may be employed within the command post of the supported unit to:

(1) Assist in aviation unit base airfield control.

(2) Assist in minor demolition work.

(3) Assist staff sections by performing map and aerial photo work.

(4) Augment local security by acting as interior and exterior command post guard.

c. Training and maintenance should take priority over performance of secondary missions.

Section II. PATHFINDER PLANNING

10. GENERAL.

a. This section provides guidelines to pathfinder units preparing for operations. Planning procedures for pathfinder operations will vary from the highly detailed to the very brief depending on the type operation and the time available. However, the inherent scope and speed of airmobile operations will in most situations limit pathfinder planning time and force a reliance on brief oral orders.

b. The troop leading procedures discussed in FM 7-15 are applicable to pathfinder units. Additional considerations necessary for pathfinder planning are outlined below.

11. WARNING ORDER. Upon notification of a pending operation the pathfinder unit commander or senior pathfinder present must alert his personnel at the earliest practicable time. This alert may be in the form of, or followed as soon as possible by, a warning order. The warning order should include sufficient information so that initial preparations can be made. It should at least include:

a. Brief statement of enemy and friendly situation.

b. Mission.

c. Individual uniform and equipment (if not SOP).

d. Equipment required and work priority for preparation (if not SOP).

e. Instructions for issue of rations, ammunition, and special equipment (if applicable).

f. Place, time and uniform for receiving operations order.

12. INITIAL PREPARATIONS.

a. Inspection of personnel and equipment begins upon receipt of the alert or warning order. Personnel and equipment augmentations, if required, should be accomplished at this time.

b. Equipment should normally be prepared according to the following priority:

(1) Radios.

(2) Navigational aids.

(a) Electronic.

(b) Visual.

(3) Weapons and essential individual equipment.

(4) Assembly aids.

(5) Miscellaneous items.

c. Whenever possible, initial liaison with the supported aviation and/or ground unit by the pathfinder unit commander or his representative should be made at this time.

d. As additional information is received, personnel and equipment are reorganized as necessary to better accomplish the mission. Time permitting, rehearsals should be conducted using terrain that most nearly resembles the operational area and all available briefing aids.

e. Security is mandatory for the success of an operation. Therefore, personnel should be provided the minimum essential information needed to complete each phase of an operation. Individuals who have received detailed information should be isolated for security. Operating situations will dictate exact security requirements.

13. COORDINATION.

a. Commanders of ground and aviation units coordinate and preplan the details of operations which require pathfinder assistance. The pathfinder commander may be required by the aviation or ground unit commanders to make recommendations on the exact location of drop zones or landing sites, landing formations, techniques to be employed, and time schedule to be followed. This is likely to occur during any type operation conducted (combat assault, reinforcement, artillery displacement, resupply or evacuation). The actual drop or landing zone is selected by the supported unit commander after considering his mission, the terrain, the friendly and enemy situation, and the advice of the pathfinder and aviation unit commanders or their designated representatives.

b. During the preparation for an operation, aviation and ground unit commanders coordinate such matters as:

(1) Ground tactical plan.

(2) Designation of supported ground unit(s) and any attached aviation units.

(3) Number and type of loads (personnel, supplies, equipment).

(4) Number and type of aircraft available.

(5) Time schedule.

(6) Plan for landing and loading in staging area.

(7) Primary and alternate flight routes.

(8) Location of release point(s) (RP) and communications checkpoint(s) (CCP).

(9) Primary and alternate landing/drop zones.

(10) Landing direction and formation.

(11) Control procedures.

(12) Location and marking of assembly points (if used).

(13) Visual and electronic navigational aids.

(14) Ground-to-air control frequencies and call signs.

(15) Location and duration of preplanned artillery and/or air strikes.

(16) Procedures for requesting on call fire support (armed helicopters, artillery and tactical air).

(17) Supported unit frequencies and call signs.

c. The pathfinder commander is vitally interested in all of the above information and will normally participate in all or part of the coordination. He uses this information in the formulation of his final plan for conduct of the operation by pathfinders. A detailed knowledge and understanding of the air movement phase of an operation is required by the pathfinder to insure that he can safely and efficiently control all aircraft in and around the drop and/or landing zones. Aviation and ground commanders must keep pathfinders informed of all changes in plans and landing sites or any emergency situations. The pathfinder commander must insure that all pathfinder activities are closely coordinated with all agencies or units involved. Necessary information must be disseminated to and thoroughly understood by all pathfinders involved in the operation.

d. Based upon coordinated plans for the operations, the pathfinder commander requests any necessary augmentation in personnel and equipment. He bases this request upon the following requirements:

(1) The mission.

(2) The planned use of personnel and/or equipment for security.

(3) The requirement to assist in assembly of personnel, supplies, and equipment of supported units.

(4) The need for assistance in the removal of obstacles.

(5) CBR survey or monitoring requirements.

(6) The assistance required for transporting and operating navigational aids under pathfinder direction.

e. Personnel and equipment augmentation should be kept to an absolute minimum and must be in keeping with the transportation means to be used in delivering the pathfinder party. When reinforced, the pathfinder party remains under the full command of the pathfinder commander who is responsible for the functions of the entire team.

14. JOINING WITH THE SUPPORTED UNIT. If not already colocated with or in support of, pathfinders join the supported unit at the appointed time and place. This normally will occur in sufficient time to allow a final coordination meeting between pathfinder, aviation and lifted ground unit representatives. However, if pathfinders enter a landing site or drop zone ahead of the assault echelon, and have been designated to accompany and provide continuous support to a ground unit, the joining with the supported unit will normally occur after the initial phase of the air movement has been completed.

15. FINAL PREPARATIONS.

a. The pathfinder commander issues his operations order as soon as practicable. The operations order may be issued as a series of fragmentary orders based upon available information or the necessity to disseminate it. The commander assures that individuals receive a detailed briefing of their exact duties. They should be given an opportunity to study pertinent maps, aerial photos, and terrain models of the objective area. Pathfinders, in particular, must be thoroughly briefed on the location and operation of proposed air-landing or air-delivery facilities, flight routes, flight formations, time schedules, release points, and communication checkpoints.

b. A final detailed check is made of the equipment to be used in the operation. A decision is made on the exact manner in which the equipment is to be transported into the objective area. All items of equipment are prepared for rapid displacement.

c. A final weather and operations briefing within the pathfinder element involved is held just prior to departure. Any final coordination between the pathfinders and supported units should also be effected at this time.

16. ORGANIZATION FOR COMBAT.

a. Pathfinders are organized for combat to meet the specific requirements of the mission. In the majority of operations, the average size of the pathfinder element at a given landing site or drop zone, or in continuous support of an infantry battalion, will be 3-6 men.

b. A pathfinder section will seldom be employed as a unit at a single location. In tailoring his unit for the accomplishment of the majority of missions, the pathfinder unit commander should expect and plan for widely separated and disconnected operations by elements of his unit.

17. DELIVERY OF PATHFINDERS. Pathfinders can be delivered by any of a variety of ground, sea, or air transportation means. The means most often employed is landing by helicopter.

18. AIR DELIVERY.

a. Landing by Helicopter.

(1) Landing by helicopter is more accurate and flexible than parachute delivery and can be carried out under marginal weather conditions. In certain areas, however, terrain conditions may initially preclude helicopter landings. Rappelling techniques permit trained personnel to land from helicopters hovering over unsuitable landing areas. The use of "trooper ladders" from hovering helicopters also allow personnel to be either landed or withdrawn from such areas. More personnel and equipment in a better state of operational readiness can be delivered when landing by helicopter. Use of helicopters furnishes a means of aerial radiological monitoring; rapid shifting or evacuation of pathfinders; enables nonparachutists to accompany pathfinders in a supporting role; and offers a delivery means when rain or low ceilings prohibit parachuting.

(2) When possible, the pathfinder element enroute to an operational area should be transported in two or more helicopters.

(3) When available, it is desirable that one helicopter remain in the vicinity of the landing area to provide pathfinders with an alternate means of transportation, observation, and communication.

b. Parachute Delivery.

(1) Parachute delivery from airplanes normally affords greater range and speed of movement than air landing by helicopter. For short range operations, helicopters may be used as jump aircraft.

(2) Depending upon wind conditions, pathfinders should compute their desired parachute release points prior to arrival in the drop area. Parachute jumps are made at the lowest practicable altitude in order to assure accuracy and security. Jump altitudes and procedures for personnel are prescribed in standing operating procedures for the types of aircraft involved and will vary in accordance with peacetime and wartime restrictions (See TM 57-220).

(3) When parachuting into an area, pathfinders carry on their persons the essential operational items of equipment that they are to employ. This technique insures maximum protection of fragile items and provides immediate access to operational equipment upon landing.

(4) Parachute entry into an area has its greatest application during non-illuminated, non-supported night operations when secrecy is a primary consideration.

c. Landing by Airplane.

As compared to helicopter delivery, landing by airplane gives greater range and speed of movement. The necessity for comparatively large, obstacle-free landing areas, however, limits the use of airplanes for pathfinder delivery.

19. MOVEMENT BY WATER. Delivery by water includes the use of any surface and underwater craft. When landing from the sea, this means of delivery is considered the most secure up to the point of debarkation from the parent craft. Small boats may also be used on inland water ways in certain situations. Movement from landing point to final destination is accomplished by land infiltration.

20. OVERLAND MOVEMENT AND STAY-BEHIND.

a. Overland Movement. Infiltration by land is generally the least desirable means of delivery and is usually limited to short movements by small elements. Land infiltration is best accomplished under conditions of limited visibility over difficult terrain, and when the enemy's lines are overextended, the combat zone fluid, or portions of his boundaries are inadequately secured. Conversely, a well-organized, stable and closely knit defense in depth may prohibit land infiltration. Overland movement to an objective may be used in conjuntion with parachute or air-landed infiltration to enhance security of an operation when sufficient time is available.

b. Stay Behind. Stay-behind involves prepositioning pathfinder elements within a proposed operational area while a friendly force withdraws from the area. Stay-behind operations may be considered when the enemy has the capability of over-running friendly areas and an airmobile attack has been planned to reoccupy the area, or as a deceptive measure to lure enemy forces into a position where they are vulnerable.

21. CONDUCT OF OPERATIONS.

a. Pathfinder-trained personnel are capable of providing air traffic control or navigational assistance within designated landing or drop zones for airplanes and helicopters or a mixture of both. They can also operate LOLEX zones and perform limited CBR reconnaissance. The degree of support provided by pathfinder units will often be dictated by the availability of pathfinders, the tactical plan, the complexity of the operation, and the state of airmobile proficiency of the lifted unit. In any airmobile operation, however, positive aircraft control is essential.

b. Daylight Assault. During daylight airmobile assault operations, pathfinders normally accompany the initial assault elements into the landing zone. Air traffic control and other pathfinder assistance is then provided to all succeeding lifts of troops, supplies and equipment. If pathfinders precede assault elements, the time may vary from a minimum of 3-5 minutes to several hours, depending upon the situation. The tactical plan, to include prestrikes in and around the landing area by artillery, Air Force aircraft or armed helicopters, will dictate this time, or preclude the early entry of pathfinders altogether.

c. Night Assault.

(1) During non-illuminated night helicopter assault operations, pathfinders should be delivered ahead of the main body. The time by which pathfinders will precede the assault echelons will be dictated by the type and extent of prestrikes, the size of the operation, navigational difficulties anticipated, and the condition of the landing site. Personnel from the supported unit and/or engineers may accompany pathfinders to provide security and assist in clearing obstacles in order that pathfinder personnel are free to reconnoiter the landing site, install visual and electronic aids, and establish air traffic control. The method of delivering pathfinders at night will be determined by security and operational requirements. They may either be parachuted onto or near objective areas, airlanded in total blackout, or airlanded with minimum illumination. The last method is the most accurate and desirable, permitting a hasty visual reconnaissance of the landing site, and thereby reducing the time by which pathfinders must precede the main body.

(2) Night airmobile operations may also be carried out under total illumination by flares or other artificial means. In this situation, the tactical plan will dictate whether pathfinders accompany the initial assault echelon as in day operations or precede the main body by a minimum amount of time. In either case, it is desirable that pathfinder lighting be used to identify specific touchdown points for individual aircraft within formations.

d. Withdrawal. It is desirable to employ pathfinders during all airmobile withdrawal (extraction, pickup) operations, both day and night. Preplanned artillery fires and/or airstrikes, as well as the maintenance of ground security to the last possible moment, make it essential that positive control of supporting aircraft exists throughout the operation. As the ground force reduces in size at a landing site, its vulnerability to attack increases. Operations must be carefully planned and aircraft closely controlled to insure that they land at desired points in the extraction area within ground security, thus enhancing the expeditious and safe flow of personnel, supplies, equipment and aircraft from the area. If not already present on the ground with the lifted unit, pathfinders should arrive at the extraction site in sufficient time to insure a thorough reconnaissance of the area and effective coordination with the lifted unit.

e. Staging Areas. Pathfinders can be employed in staging areas to provide air traffic control in the absence of air traffic control units. They may also act as liaison between the aviation and ground units and assist the ground unit commander in the preparation and positioning of troops, supplies and equipment for air movement. When a temporary staging area is established to support an operation of short duration, pathfinders should be present in the area far enough in advance of the operation to insure complete reconnaissance, marking, coordination, and establishment of positive air traffic control. Positive air traffic control in staging areas is essential to insure safe, efficient and expeditious movement of the large numbers of helicopters and airplanes that can be expected in and around such areas. This need for control increases as the number and type of aircraft increases, mechanical failures occur, or changes in plans are made.

f. Artillery Displacement. Pathfinders should be employed to facilitate the rapid and safe displacement of artillery, both day and night. Thorough coordination with the artillery unit commander or liaison officer and a complete understanding of ground and aviation unit SOP is essential to insure accurate and efficient delivery of pieces, personnel and ammunition.

g. Support of Ground Operations. Pathfinder personnel may be attached to ground units to provide around-the-clock assistance to and control of aircraft during operations requiring sustained support by Army aircraft. Pathfinders attached to infantry battalions may be further attached to companies to provide support, consistent with availability of personnel and equipment. Such continuous support greatly enhances overall operating efficiency and aviation safety during all types of airmobile operations. However, this type support cannot be habitually accomplished by units possessing

only limited pathfinder resources. In such cases, pathfinders are employed on a short-term, mission basis wherever they can best assist in accomplishment of overall major unit missions. In the absence of personnel from pathfinder units, selected personnel in the ground units must be trained and prepared to provide minimum required assistance to supporting aircraft.

h. Drop Zones and Airplane Landing Zones. Pathfinders may also be employed to operate resupply or personnel drop zones and airplane landing strips, both day and night. In the absence of US Air Force Combat Control Teams, and by joint agreement, Army pathfinders may control USAF aircraft in both drop and landing zones. However, it may be necessary to provide pathfinders with communications equipment (UHF, VHF) that is compatible with these aircraft.

i. Mixed Operations. Situations will often exist that require provisions for and simultaneous control of mixed operations at the same location; i.e., resupply parachute drops into forward helicopter landing sites. As a rule, helicopter traffic can be expected at all fixed wing airfields. Mixed air traffic often presents difficult control problems and strict control measures must be applied. Landing, parking, loading, unloading, refueling and rearming areas must be designated, coordinated, and clearly identified to insure smooth operations.

22. COMMUNICATIONS.

a. An essential element of a successful pathfinder operation is communications by ground-to-air voice radio. This radio should be the first item placed in operation at a landing site or drop zone and should be the last item taken out of operation. Pathfinders must have a thorough understanding of voice radio procedures, to include phraseology unique to air traffic control (See Appendix IV). Communications must be clear, concise, applicable, accurate and correctly timed. To achieve the necessary speed and clarity of transmission, radio discipline must be practiced by pathfinders and aviators. Extraneous and unnecessary messages must be omitted. Pathfinder air traffic control frequencies should be used for that purpose only, except in emergencies (Figure 1).

b. Because of the amount of vital information exchanged, the copilots of aircraft normally record the important portions of ground-to-air messages to insure that proper instructions are understood and followed. For examples of ground-to-air message transmissions, see paragraphs 30b, 36b, 43b, and 47a.

c. Pathfinders use electronic homing beacons, visual aids, and arm and hand signals to complement voice communications. Aviators and transported troops must understand the purpose and meaning of the aids displayed and the techniques employed. A discussion of aids used is found in paragraph 6. A discussion of arm and hand signals and visual aids is found in FM 21-60, Visual Signals, and Appendix V.

d. Whenever possible, pathfinders should monitor supported unit command radio nets in order to keep abreast of rapidly changing situations that could influence pathfinder operations.

e. Positive communications must be established between pathfinder air traffic control facilities and co-located fire support elements to insure that timely and accurate information concerning friendly fires is available to aircraft.

23. TERMINAL GUIDANCE BY SUPPORTED UNITS.

a. There will be many requirements to assist aircraft in areas where TOE pathfinders are not available. This type of terminal guidance will normally be furnished by selected personnel within the supported unit using organic or improvised equipment.

b. Terminal guidance personnel should be familiar with supporting aviation unit SOP and be trained to:

(1) Operate electronic and visual navigation aids to assist aircraft in locating landing/drop zones.

(2) Provide limited essential information to and guidance and control of army aircraft through ground-to-air radio.

(3) Reconnoiter for and recommend suitable landing/drop sites.

(4) Determine, recommend and/or accomplish necessary pioneer work to prepare landing/drop sites for use.

c. When TOE pathfinders accompany ground units, terminal guidance personnel will normally augment pathfinder elements.

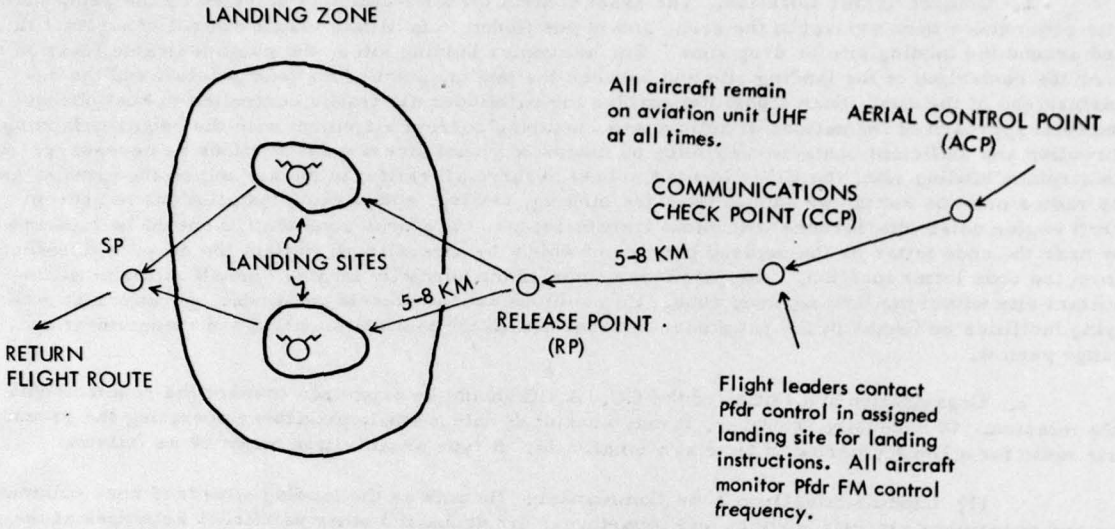


FIGURE 1. Enroute Communications Procedures with Pathfinders in Landing Zone.

CHAPTER 3

CONTROL CENTER AND RELEASE POINT

24. LANDING AND/OR DROP ZONE CONTROL CENTER.

a. General. The purpose of the control center (CC) (Figure 2) is to control air traffic in and around a landing or drop zone and to promote safe, orderly, and expeditious air movement. The control center is the pathfinder command post and communications center for a particular landing site or drop zone.

b. Control Center Location. The exact control center location is selected by the pathfinder site commander upon arrival in the area, and is positioned to facilitate visual control of aircraft in and around the landing site or drop zone. For helicopter landing sites, the most desirable location is near the centerline of the landing site and between the landing point of the lead aircraft and the departure end of the site. Such a position enables the pathfinder air traffic controller to best observe the final approach of formations of helicopters, insuring correct alignment with the required landing direction and sufficient obstacle clearance by means of visual steering instructions as necessary. At an airplane landing site, the CC is located to best observe all traffic in the air and on the ground, and its radios must be set up far enough from the landing, taxiing, and parking installations to prevent aircraft engine noise interference with radio transmissions. At a drop zone the CC should be located at or near the code letter or the desired point over which the aircraft will initiate the drop, if different from the code letter location. The pathfinder commander normally locates himself at the most important site within the landing/drop zone. He monitors and/or directs pathfinder operations at outlying facilities by means of the pathfinder internal net, if the tactical situation and communication range permit.

c. Organization and Duties of the CC. A CC should be organized to meet the requirements of the mission. Of necessity, however, it may consist of only a single pathfinder operating the ground-to-air radio for a limited period of time at a small site. A type organization might be as follows:

(1) Landing Site/Drop Zone Commander. He acts as the landing site/drop zone commander and supervises aircraft landings and departures, air drops and other pathfinder activities at the site. For maximum utilization of available personnel, he may also be the ground-to-air radio operator ((2) below).

(2) Ground-to-Air Radio Operator. He operates the radio used to maintain communication with aircraft, and provides the necessary voice air traffic control for his control zone.

(3) Internal net radio operator. He operates the radio used to maintain communication with other pathfinder elements when such a net is applicable and required. He aids in the control of aircraft by observation, and maintains a record (Appendix I) of aircraft arrivals and departures and the general types of loads, if required.

(4) Other Personnel. They are used to assist in carrying and installing equipment, clearing and/or marking of obstacles, and provide any other assistance necessary.

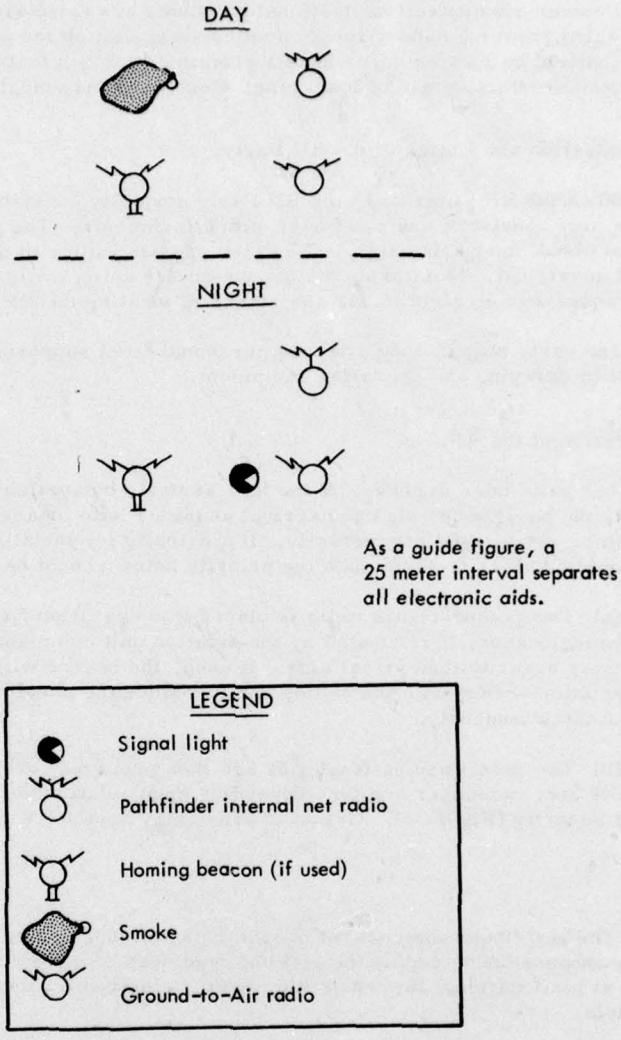


FIGURE 2. Control Center (CC)

25. RELEASE POINT.

a. General. A release point (RP) (Figure 3) is an established traffic control point and final navigational checkpoint for aircraft approaching the landing or air-delivery facilities within a landing/drop zone. The RP is also used by helicopter serials as a final coordination point for control of preplanned ground or aerial supporting fires in and around landing sites during the air movement phase of an airmobile assault. The RP is normally not manned unless the location coincides with a relatively secure area or if extremely difficult navigational problems are anticipated by the aircraft. The location is tentatively selected from map and airphoto studies as a point on the planned flight route to the landing zone. Ideally, it should be located on/or near a prominent terrain feature or on high, open terrain which allows maximum effective use of long-range electronic and visual navigational aids.

b. Organization and Duties of the RP Party.

(1) When the RP is manned, the RP Party normally consists of two or three pathfinders, or as a minimum may consist of one pathfinder with attachments. The pathfinders position and operate the electronic and visual navigation aids. They also operate radios in the pathfinder internal net (if used) and ground-to-air net. Monitoring the ground-to-air net permits personnel at the RP to respond immediately to requests from aircraft for assistance in locating the RP.

(2) The party may include attached personnel from supported units to provide security for the RP and assist in carrying and operating equipment.

c. Operation of the RP.

(1) The pathfinder in charge of the RP, assisted by available personnel as needed, immediately installs the navigation aids upon arrival at the RP site or according to plan. Whenever possible, aids should be established concurrently. If a priority for installing these aids is required due to limited personnel or other factors, then the priority below should be used.

(a) The ground-to-air radio is placed into operation first. Following this would be the electronic homing beacon, if requested by the aviation unit commander, since it affords long-range guidance and greater security than visual aids. If used, the beacon will be located far enough away to prevent excessive interference with the radios and to reduce the possibility of enemy fire destroying radios and beacon simultaneously.

(b) The visual navigational aids are then prepared for operation. Visual navigation aids employed will vary in number and type depending upon aviation unit SOPs and requirements, and the necessity for security (Figure 3). Grass or brush may have to be removed to prevent masking these aids.

(2) The pathfinder internal net operator establishes communication with the landing site CC(s) as quickly as possible to report the state of readiness of the RP and provide information in the enemy situation at his location. He constantly monitors his radio unless directed to operate on a definite time schedule.

(3) Security personnel move to assigned locations and take up security positions or assist in establishing and operating navigation aids and communication equipment.

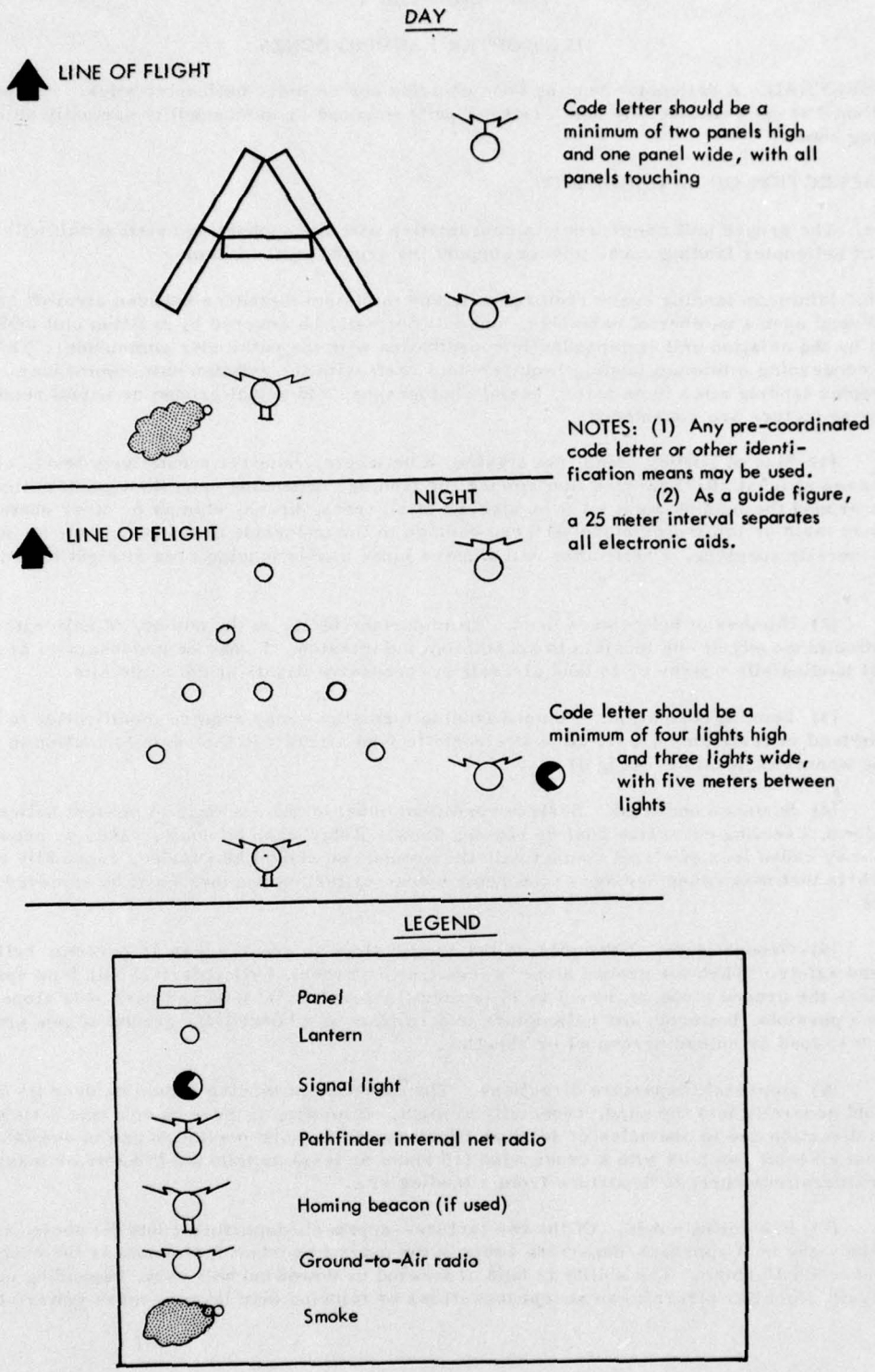


FIGURE 3. Release Point (RP)

CHAPTER 4

HELICOPTER LANDING ZONES

26. GENERAL. A helicopter landing zone contains one or more helicopter sites. A control center is established at each landing site and a release point (manned or unmanned) is normally selected for the landing zone.

27. SELECTION OF LANDING SITES.

a. The ground unit commander in coordination with the supporting aviation unit will select the location of helicopter landing zones to best support the ground tactical plan.

b. Minimum landing space requirements and minimum distances between aircraft on the ground depend upon a number of variables, and will normally be covered by aviation unit SOPs or prearranged by the aviation unit commander in coordination with the pathfinder commander. The final decision concerning minimum landing requirements rests with the aviation unit commander. In selecting helicopter landing sites from maps, aerial photographs, and actual ground or aerial reconnaissance, the following factors are considered:

(1) Size of landing point. As a guide, a helicopter requires a relatively level, cleared, circular area at least 20-75 meters in diameter for landing, depending upon the type of helicopter. The area around the landing point must be cleared of all trees, brush, stumps or other obstacles that could cause main or tail motor blade strikes, damage to the underside of the helicopter or other hazards. Generally speaking, a helicopter will require more usable landing area at night than during the day.

(2) Number of helicopters used. An important factor is the number of helicopters required to land simultaneously at one location to accomplish the mission. It may be necessary to provide an additional landing site nearby or to land aircraft in successive flights at the same site.

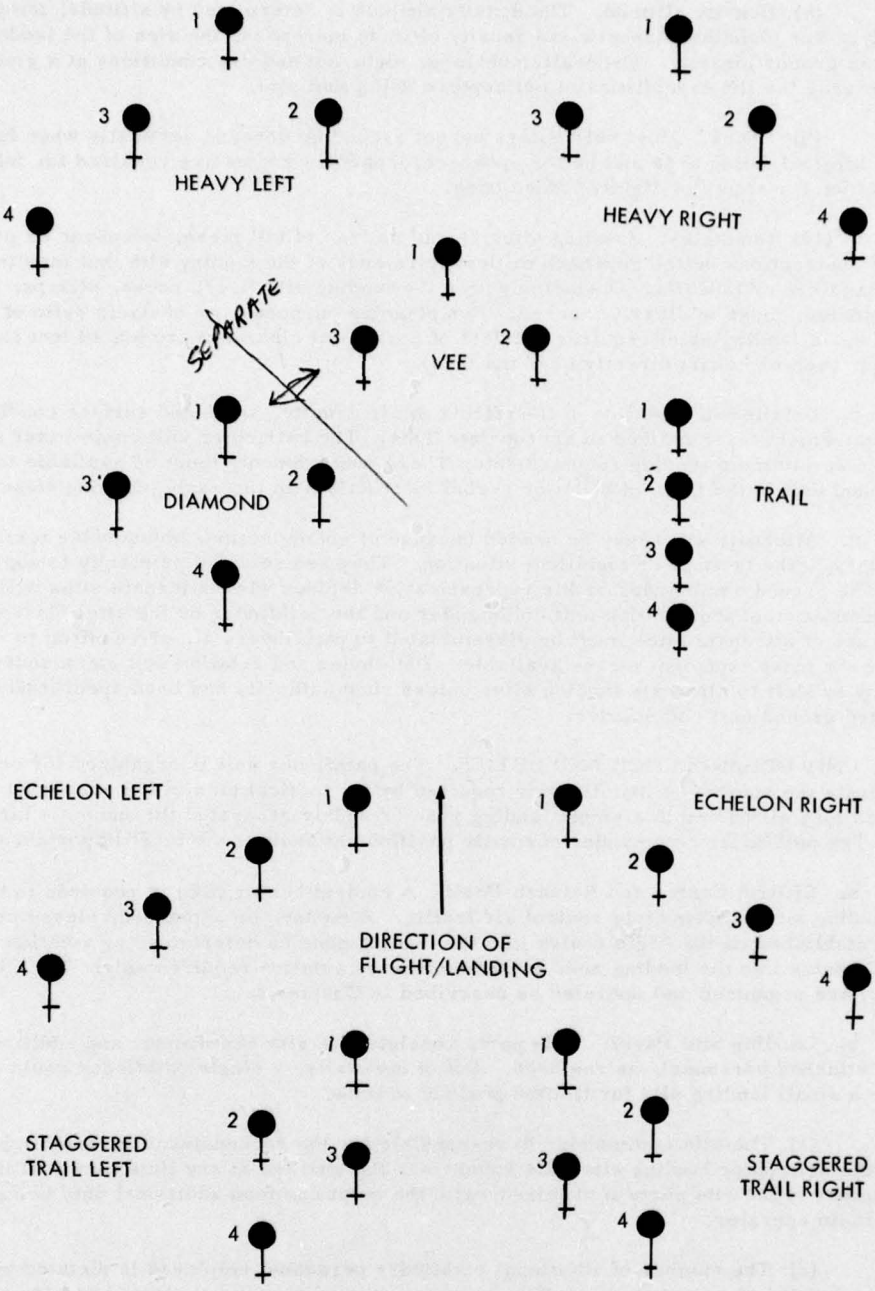
(3) Landing formation. Planned landing formations may require modification to allow helicopters to land in restricted areas. It is desirable to land aircraft in the same formation in which they are flying whenever possible. (Fig 4)

(4) Surface conditions. Surface conditions must be firm enough to prevent helicopters from bogging down, creating excessive dust or blowing snow. Rotor wash on dusty, sandy or snow covered surfaces may cause loss of visual contact with the ground and should be avoided, especially at night. Loose debris that may cause damage to the rotor blades or turbine engines must be removed from landing points.

(5) Ground slope. Normally, if the ground slope is greater than 15 percent, helicopters cannot land safely. When the ground slope is less than 7 percent, helicopters should land upslope. In areas where the ground slope is from 7 to 15 percent, aircraft must land and park side slope. It is sometimes possible, however, for helicopters to terminate at a hover over ground slopes greater than 15 percent to load or unload personnel or supplies.

(6) Approach/departure directions. The direction of landing should be over the lowest obstacles and generally into the wind, especially at night. However, if there is only one satisfactory approach direction due to obstacles or tactical situation, or to make maximum use of available landing area, most aircraft can land with a cross wind (10 knots or less) or tailwind (5 knots or less). The same considerations apply to departure from a landing site.

(7) Prevailing winds. Of the two factors--approach/departure route (6) above and prevailing wind--the best approach/departure route is the more important factor unless the cross wind velocity exceeds 10 knots. The ability to land crosswind or downwind will vary, depending upon the type aircraft. Smaller aircraft can accept less cross or tailwind than larger, more powerful aircraft.



LEGEND:

= Helicopter

Figure 4. Standard Flight and Landing Formations.

(8) Density altitude. The density altitude is determined by altitude, temperature and humidity. For planning purposes, as density altitude increases, the size of the landing site must be increased proportionately. Generally speaking, high, hot and dry conditions at a given landing site will decrease the lift capabilities of helicopters using that site.

(9) Loads. Most helicopters cannot ascend or descend vertically when fully loaded; therefore, a larger landing area and better approach/departure routes are required for fully loaded helicopters than for empty or lightly loaded ones.

(10) Obstacles. Landing sites should be free of tall trees, telephone or power lines, or similar obstructions on the approach or departure ends of the landing site that may interfere with helicopter landings or takeoffs. Obstacles within the landing site (i.e., rocks, stumps, holes) that cannot be eliminated, must be clearly marked. For planning purposes, an obstacle ratio of 10 to 1 will be used (i.e., a landing point requires 100 feet of horizontal clearance from a 10 foot tree if aircraft must approach or depart directly over the tree).

c. Detailed information of the effects of air density, slope and surface conditions on landing site requirements is contained in appropriate TMs. The helicopter unit commander makes the final decision on minimum landing requirements. These requirements must be available to the pathfinder and ground unit in the form of SOPs or verbal instructions in the early planning stages of the mission.

d. Alternate sites may be needed because of enemy action, unfavorable terrain conditions, or changes in the tactical or logistical situation. They are selected primarily to support the tactical plan. The ground commander or his representative decides when alternate sites will be used, at the recommendation of the aviation unit commander and the pathfinder on the site. Instructions concerning the use of alternate sites must be disseminated to pathfinders at, or required to move to, alternate sites by the most expedient means available. Pathfinder and aviation unit commanders do not have the authority to shift to alternate landing sites unless such authority has been specifically delegated by the supported ground unit commander.

28. UNIT ORGANIZATION AND DUTIES. The pathfinder unit is organized for combat to establish and operate the number of installations required by the tactical plan of the supported unit(s). These facilities may all be within a single landing zone or widely separated throughout a large area of operations. The pathfinder commander normally positions himself at the most important site.

a. Control Center and Release Point. A control center (CC) is required to be established at each landing site to adequately control air traffic. A manned or unmanned release point (RP) is normally established on the flight routes into the landing zone as determined by aviation requirements. The CC routes into the landing zone as determined by aviation requirements. The CC and RP (when manned) are organized and operated as described in Chapter 3.

b. Landing Site Party. This party consists of a site commander and additional pathfinder and/or attached personnel, as required. Out of necessity, a single pathfinder could establish and operate a small landing site for limited periods of time.

(1) The site commander is responsible for the reconnaissance, establishment, and operation of the helicopter landing site. He supervises the site and at any time may perform the duties of any member of the site party if required, with the most common additional duty being that of ground-to-air radio operator.

(2) The number of additional pathfinder personnel employed is dictated by size of the landing site, density of expected air traffic, number and type visual and electronic aids to be used, and the tactical situation. They will operate the ground-to-air radio, pathfinder internal net radio (if established), position and operate navigational and assembly aids, and clear and/or mark all obstacles within their capabilities.

(3) Other personnel from supported units may be attached to the landing site party to provide security, assist pathfinders in establishing and operating the landing site, reconnoiter and mark assembly areas, and operate assembly aids. Use of attached personnel, if any, to assist pathfinders should be carefully planned ahead of time. These personnel must be thoroughly briefed and rehearsed, and any reconnaissance assignment should not include actual landing areas which should only be reconnoitered by pathfinders.

29. ESTABLISHMENT OF THE LANDING SITE.

a. Communications are established in the ground-to-air net, and pathfinder internal net (if used) immediately upon arrival at the landing site. These radio nets are monitored at all times, unless otherwise directed, until operations at the site are completed. It is desirable that each helicopter landing site be within ground communications range of the other sites and the release point, if manned. However, the tactical situation may often preclude this. The range of available radios will dictate the ability to communicate with other facilities within the landing zone.

b. The helicopter landing site commander rapidly reconnoiters the area to determine the exact direction of landing, and calculates an intercept heading from the RP, if necessary (see (6) below). He selects the location of the landing point of the lead aircraft of each flight and determines if the terrain or situation dictate any change to the preplanned landing formation. The site commander must also insure that necessary landing instructions are compiled for transmittal to inbound aircraft, and that obstacles to aircraft in or around the site are expeditiously removed or marked.

(1) Preferably, helicopters should land simultaneously in the preplanned flight formations (Fig 4). If it becomes necessary to land the helicopters in a formation different from that in which they are flying, the landing site commander must insure that this information is given to the flight leader as part of the landing instructions (para 30). Exact layout of the landing site depends upon the helicopters not flying directly over other aircraft on the ground, available landing space, number and type of obstacles, unit SOPs, and prearranged flight formations. When helicopters are to land in trail formation, the landing points should be staggered laterally unless terrain dictates otherwise (i.e., landing on a road) to reduce the danger of collision, especially at night.

(2) Normally, no landing zone marking at all is used during day operations except smoke or other minimum identification means, and for obstacles that may be difficult to detect and impossible to remove (i.e., wires, holes, stumps). Lanterns or field expedients are used to indicate the direction of landing and mark individual landing points for a night operation (Fig 6, 7, 8, 9, and 10). Lights of different colors may be used to designate different helicopter sites or separate platoons within a larger formation. A lighted tee indicates the landing point of the lead aircraft of each platoon and the direction of approach. Additional lights are provided for touchdown points of other aircraft in the flight. Helicopters should land with the right landing gear or skid just to the left of the light. All lights should be hooded or turned upside down for security purposes until the last practicable moment when aircraft are inbound. Lights should be beamed in the direction from which the helicopters approach. It is desirable that a signalman be used to land the lead aircraft, especially at night.

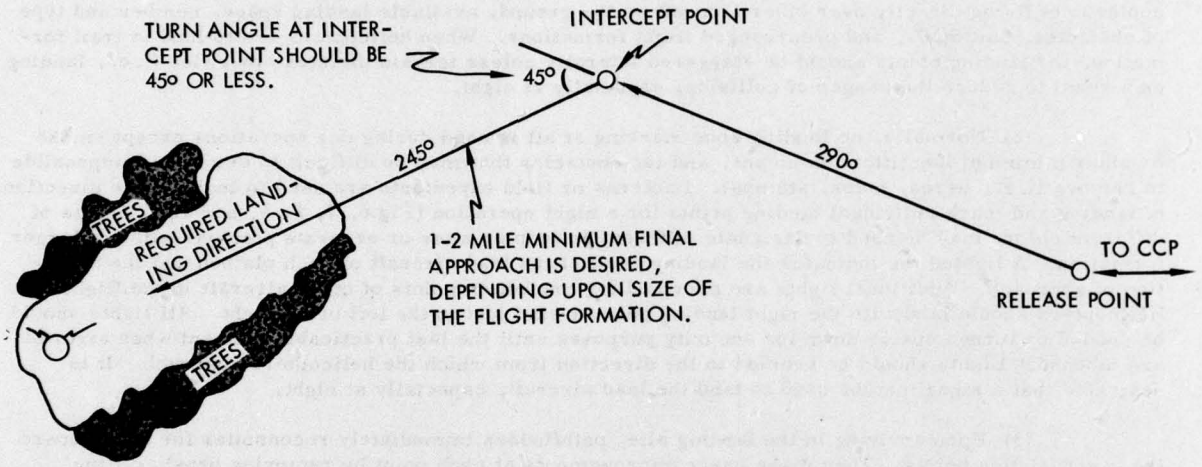
(3) Upon arriving in the landing site, pathfinders immediately reconnoiter for and prepare the exact landing points. They make hasty improvements at each point by removing brush, filling holes, etc. They remove obstacles or mark them with red panels or red lights, as required. Improvement of the site should be continued as long as necessary, or until the mission is completed at the location.

(4) Pathfinders may mark initial assembly points for troops, equipment and supplies if required by the supported unit. These points are located to facilitate assembly in order to clear the helicopter site quickly and efficiently. If unit assembly areas are to be used, they are pre-selected by the ground unit commander. If the requirement exists, supported ground unit personnel will accompany the pathfinders to reconnoiter and mark the unit assembly areas, establish assembly aids, act as guides, and assist in loading/unloading operations to insure rapid clearance of personnel, supplies, and equipment from the immediate vicinity of the landing points.

(5) Pathfinders have a limited security capability. If pathfinders preceded the initial assault elements into a landing site, personnel from the supported ground unit may accompany them for security purposes.

(6) If at all possible, the heading from the RP to the landing site should coincide as closely as possible with the actual landing direction to preclude sharp turns with formations of aircraft. The larger the formation, the more important this becomes. If a straight-in approach for landing is not possible, then an "intercept heading" should be established (Fig 5). The intercept point should be far

enough away from touchdown to allow aircraft in formation a final approach of at least 1-2 miles. Visual steering commands, time/distance, terrain features, and electronic or visual navigational aids may be used by flight leaders to determine the intercept point with the required landing direction at the landing site.



REQUIREMENT FOR USE OF INTERCEPT HEADING AND LOCATION OF THE INTERCEPT POINT IS DETERMINED BY PATHFINDER LANDING SITE COMMANDER AFTER EVALUATION OF ALL CIRCUMSTANCES PRESENT AT HIS LANDING SITE.

Figure 5. Intercept Heading Techniques.

30. OPERATION OF THE HELICOPTER LANDING ZONE.

a. Helicopters normally approach the landing zone along a designated flight route. They are normally organized into serials containing one or more platoon size flights. One serial may contain a flight for each helicopter site. However, flights of medium or heavy transport helicopters (CH-47, CH-54) carrying artillery or other bulk cargo can often be expected to arrive at landing sites in increments of one or two aircraft at a time. Subsequent flights, follow at minimum time intervals. The minimum allowable time between flights will depend on such factors as the number of aircraft per flight, the configuration of the landing site, and the nature of cargo to be loaded or off-loaded. Time between successive flights will be determined by the aviation unit commander during the planning phase of an operation. Once an operation is in progress, pathfinders at the site may recommend changes to insure aviation safety or expedite operations.

b. As each helicopter serial reaches the communications checkpoint (CCP) on the flight route, the flight leader initiates communication with the appropriate helicopter landing site control center (CC). The CC then furnishes the flight leader with information concerning the heading from the CCP to RP, the heading from the RP to the landing site, landing direction, other pertinent information, (i.e., enemy situation, friendly fires, field elevation, landing formation, terrain conditions, traffic situation, obstacles, availability of smoke or light gun, glide slope indicator setting) and the next reporting point. Normally, all aircraft in a flight switch to the pathfinder control frequency on instructions of the flight leader prior to reaching the CCP. Radio messages between a landing site CC and a flight leader might be as follows:

SPEAKER	TOPIC	MESSAGE
Flight Leader	Identification, location	HOTEL CONTROL THIS IS HAWK ONE AT CCP, OVER.
Pathfinder at landing site	Acknowledgement	*HAWK ONE THIS IS HOTEL CONTROL;
	Heading from CCP to RP	HEADING TWO EIGHT ZERO;
	Landing site heading (from RP to landing site)	LANDING SITE HEADING TWO NINER ZERO (OR, IF INTERCEPT HEADING IS REQUIRED: HEADING FROM RP THREE ONE ZERO TO INTERCEPT TWO NINER FIVE);
	Landing direction	*LAND TWO NINER FIVE;
	Other pertinent information	*ENEMY SITUATION NEGATIVE, SMOKE ON CALL, BE ADVISED STUMPS ON LANDING SITE;
	Clearance to approach and next reporting point.	*REPORT ONE MILE FINAL.
Flight Leader	Acknowledgement	*HAWK ONE, ROGER, OUT.
Flight Leader	Identification, location	*HOTEL CONTROL, HAWK ONE; ONE MILE FINAL.
Pathfinder at landing site	Acknowledgement and final clearance to land	*HAWK ONE, HOTEL CONTROL; WIND THREE ONE ZERO DEGREES AT FIVE, CLEAR TO LAND.

SPEAKER	TOPIC	MESSAGE
Flight Leader	Acknowledgement	*HAWK ONE, ROGER.
Flight Leader	Request for permission to take-off	*HOTEL CONTROL, HAWK ONE; REQUEST TAKE-OFF.
Pathfinder at landing site	Acknowledgement and instruction for take-off	*HAWK ONE, HOTEL CONTROL; WIND THREE ONE ZERO DEGREES AT FIVE, CLEAR FOR TAKE-OFF.

*Pathfinders must be prepared at all times to provide air traffic control and navigational assistance to any aircraft in and around a landing site in the event these aircraft do not follow a specified flight route. Radio transmissions from a landing site CC to an aircraft approaching the site from a direction other than along a flight route with a specified CCP and RP would be as shown above, marked by the asterisk.

c. The helicopter formation continues along the flight route to the RP. Pilots are assisted by the electronic and visual navigational aids at the RP, if manned. All helicopters pass over or near the RP, with serial leaders normally reporting passage of the RP to their respective landing site CC, and move directly to their assigned landing site. The individual landing site CC furnishes assistance to any flight which cannot locate its site by means of visual signals, steering commands, or electronic homing techniques.

(1) For a daylight operation, a specified smoke color may be assigned to separate landing sites to aid identification. Since the number of smoke colors is limited, the same color may have to be used by more than one helicopter site. Sites that use the same color should be located farthest apart. When smoke is used, care must be taken to avoid starting grass fires or masking the landing points. Smoke should be employed sparingly because it distinctly marks a location not only for friendly forces, but for enemy observers as well. Generally, smoke is used only in response to an aviator's request for help in identifying or locating his helicopter site.

(2) For a night operation, pyrotechnics or other visual signals are used in place of smoke. As in daylight, red signals should be used only to means DO NOT LAND or to indicate other emergency conditions. Emergency codes must be preplanned and thoroughly understood by all concerned.

d. Each flight lands at its assigned helicopter site in the manner indicated by CC messages and visual aids displayed. Pathfinders may use arm-and-hand signals (Appendix V) with baton flashlights to assist in controlling the landing, hovering or parking of helicopters during night operations.

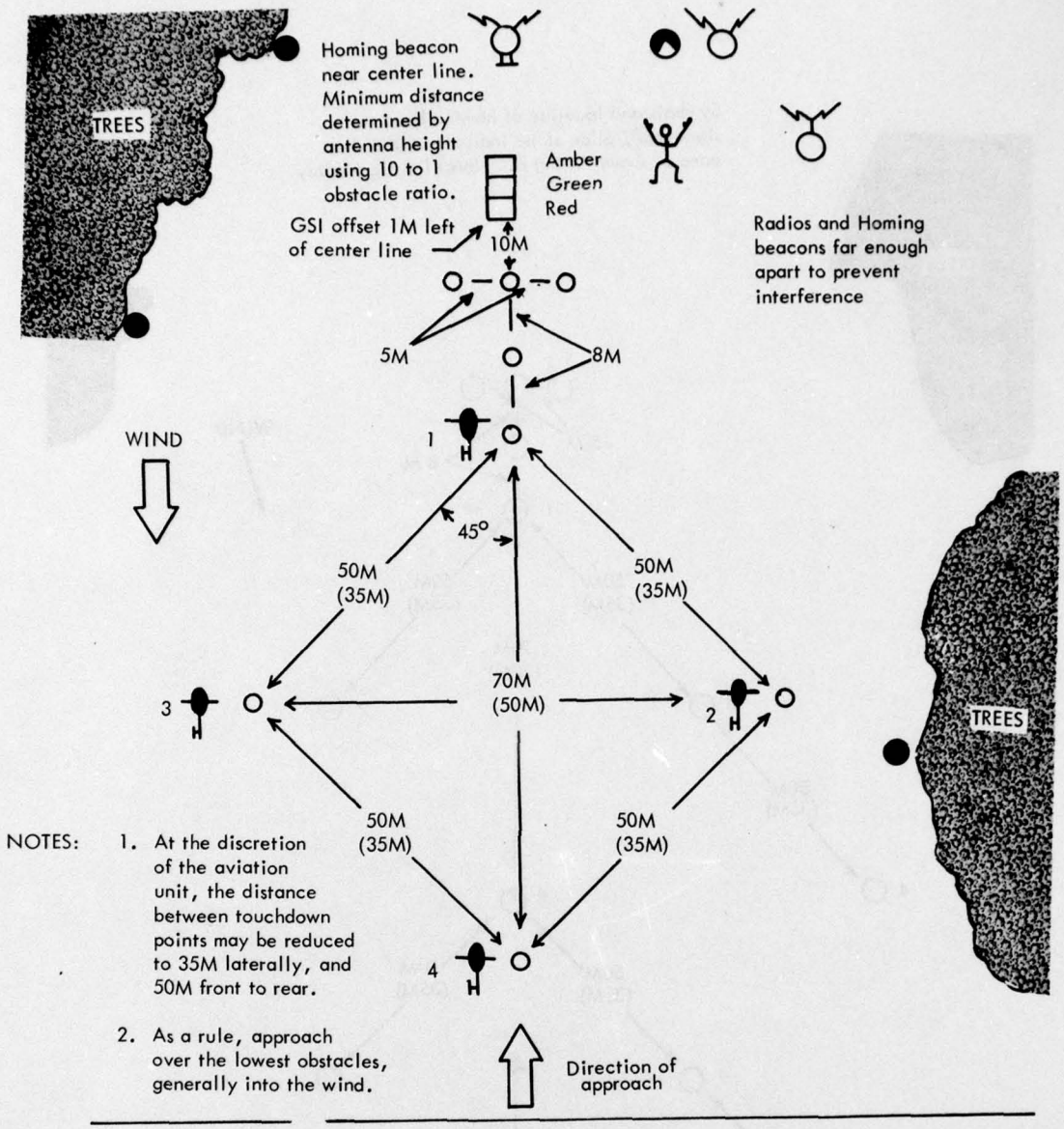


Figure 6. Night UH-1 Landing Site - Diamond Formation.

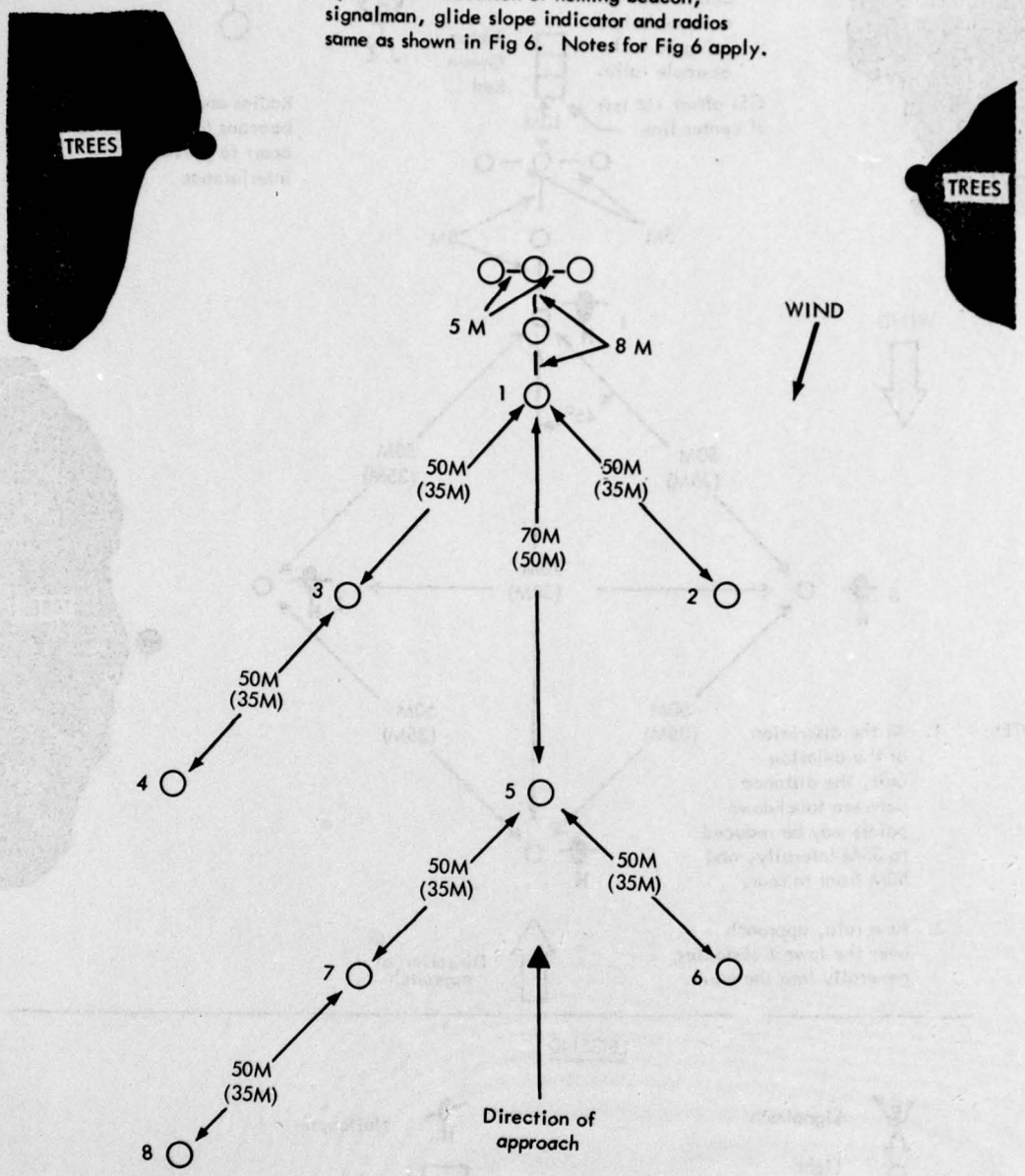


Figure 7. Night UH-1 Landing Site - Platoon Heavy Left Formation.

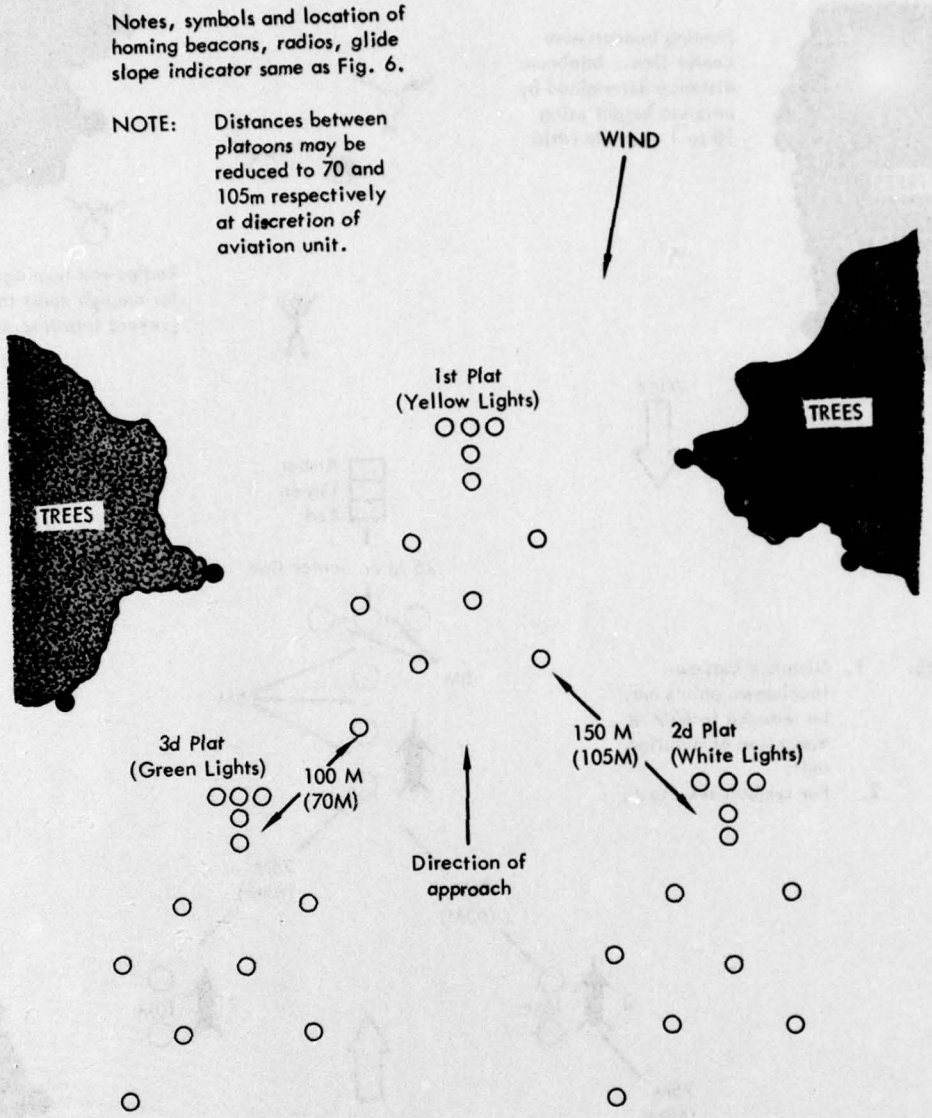


Figure 8. Night UH-1 Landing Site - Company Vee, Platoons Heavy Left.

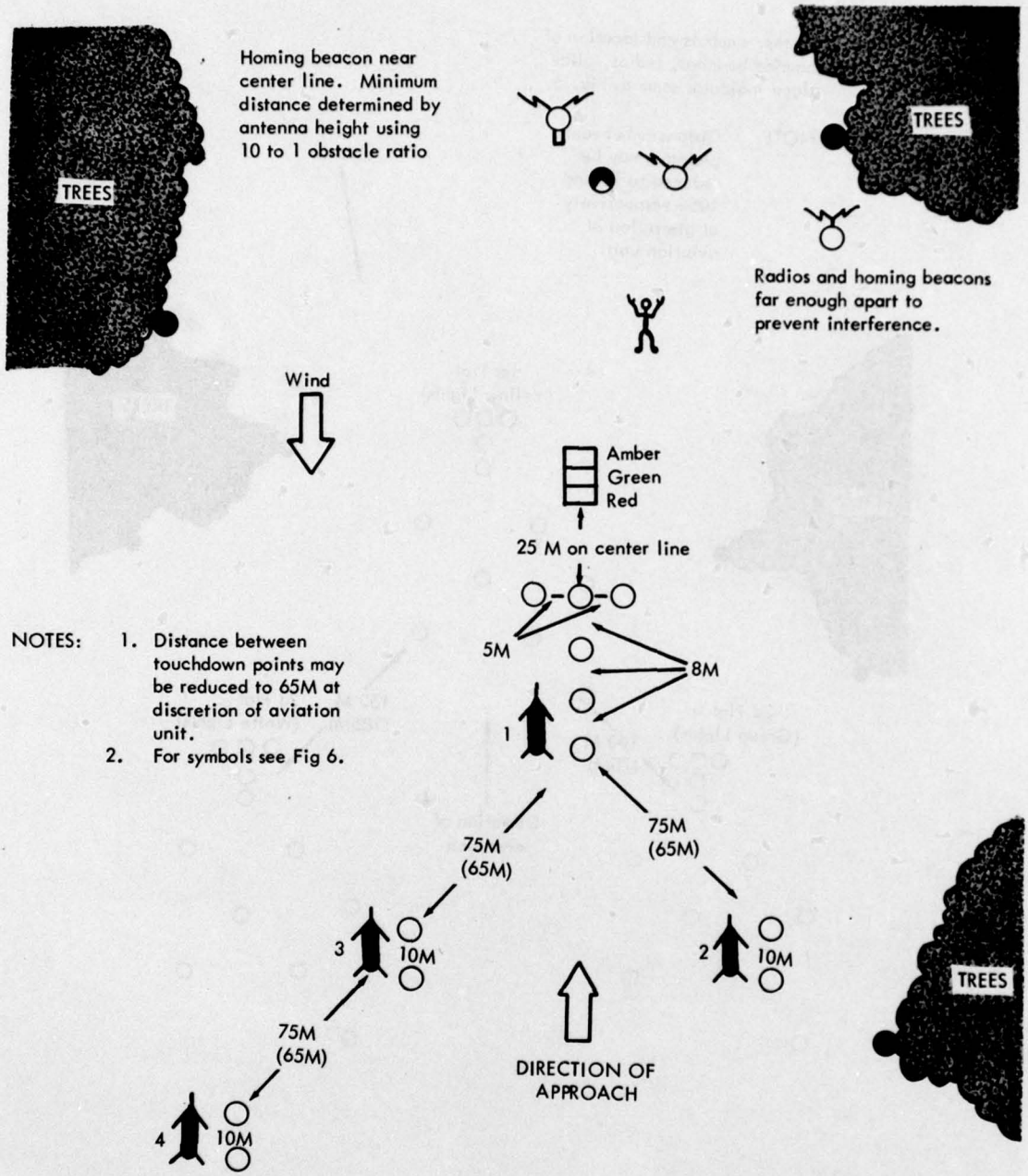
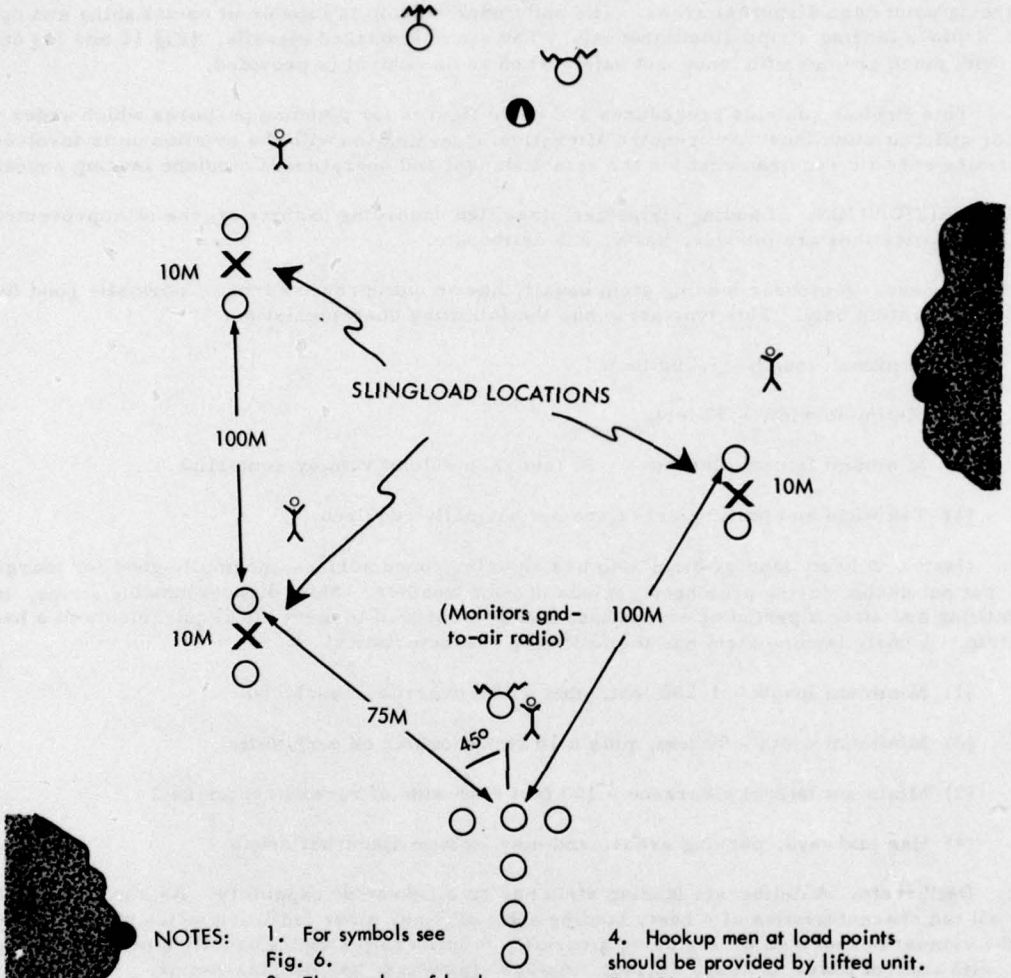


Figure 9. Night CH-47 Landing Site - Heavy Left Formation.



NOTES:

1. For symbols see Fig. 6.
2. The number of load points established is determined by available area and mission requirements.
3. Each aircraft makes approach to tee and hovers to designated load point at direction of CC.
4. Hookup men at load points should be provided by lifted unit.
5. Pfdr internal net may be used as required throughout the site.

Figure 10. Night CH-47 Slingload Pickup/Drop Site.

CHAPTER 5

AIRPLANE LANDING ZONES

31. GENERAL.

a. Airplane landing zones are established to safely and expeditiously land and take-off Army airplanes and provide adequate guidance for taxiing and parking while on the ground. An airplane landing zone has one or more landing strips. The landing strip consists of a runway, and may include taxiways, parking points and dispersal areas. The pathfinder section is capable of establishing and operating two airplane landing strips simultaneously. The strip is marked visually, (Fig 11 and 12) and operates with much greater efficiency and safety when radio control is provided.

b. This chapter contains procedures and guide figures for planning purposes which under extreme or difficult situations may require alteration. Coordination with the aviation units involved will determine specific requirements for the establishment and operation of airplane landing zones.

32. CLASSIFICATION. Landing strips are classified according to their degree of improvement. The three classifications are pioneer, hasty, and deliberate.

a. Pioneer. A pioneer landing strip usually has an unimproved surface, normally good for fair weather operation only. This type strip has the following characteristics:

(1) Minimum length - 1,200 feet.

(2) Minimum width - 50 feet.

(3) Minimum lateral clearance - 75 feet each side of runway centerline.

(4) Taxiways and parking areas are not normally required.

b. Hasty. A hasty landing strip also has an unimproved surface, normally good for marginal weather, but not usable during prolonged periods of poor weather. Most pioneer landing strips, terrain permitting and after a period of occupation, can be improved to meet the requirements of a hasty landing strip. A hasty landing strip has the following characteristics:

(1) Minimum length - 1,200 feet, plus a 10% overrun at each end.

(2) Minimum width - 50 feet, plus a 10 foot shoulder on each side.

(3) Minimum lateral clearance - 100 feet each side of runway centerline.

(4) Has taxiways, parking areas, and may include dispersal areas.

c. Deliberate. A deliberate landing strip has an all-weather capability. As a minimum, it will have all the characteristics of a hasty landing strip plus any other facilities which may be needed to meet the standards required by any using aircraft. A deliberate strip is usually a permanent installation with control tower and hard surface runways, taxiways, and parking ramps.

33. SELECTION OF AIRPLANE LANDING FACILITIES. It is usually desirable that landing strips have taxiways, parking areas and dispersal areas after a period of improvement. Landing strips should be selected in areas where these installations can be established easily, and where the various installations will meet prescribed minimum standards.

a. Landing Strips. A landing strip is a specified location within an objective area used for landing aircraft. It is selected to meet the requirements of the supported ground and using aviation unit.

(1) Surface. The surface of a landing strip must be firm and smooth enough to allow heavily loaded aircraft to land, taxi, park, and take-off without delay or damage to the aircraft.

(2) Location. The landing strip should be located in a level area, away from obstacles such as telephone wires and tall trees. If there are prevailing winds, the runway should be oriented, if possible, to enable aircraft to land and take-off into the wind.

(3) Dimensions. The minimum size of a landing strip will depend on the type loads, the direction and velocity of the wind, condition of the ground, and the location of obstacles. The minimum dimensions are coordinated between the aviation and the pathfinder units with the final decision resting with the aviation unit. As a guide, the following factors should be considered in the establishment of a landing strip:

(a) Soft, wet, slippery, or any other unfavorable surface conditions will normally increase the required length of a runway by at least 7%.

(b) Crosswinds may also require an increase in the length of the runway by at least 7%.

(c) Uphill take-offs and downhill landings may require longer runways. The maximum slope on any strip should not exceed 10%.

(d) If there are obstacles at the approach and departure ends of the strip, an obstacle clearance is measured from the obstacle to the approach and departure end panels/lights.

b. Taxiways. Taxiways should be prepared on one or both sides of the runway so airplanes can clear the runway as soon as possible after landing. Taxiways must be wide enough to permit the largest aircraft being used to taxi from the runway to the parking area. The following factors affect the location of taxiways:

(1) Taxiways parallel to the active runway should be separated from the runway by a minimum of two and one-half (2 1/2) wing spans of the largest aircraft anticipated at the landing strip.

(2) The taxiways should be one and one-half (1 1/2) times the width of the wheel base of the largest aircraft anticipated on the landing strip, but not less than twenty (20) feet wide.

(3) Taxiways must be free of obstacles, smooth, and firm enough for aircraft to taxi without being damaged or bogging down.

c. Parking Areas. Parking areas are selected where aircraft can load and unload without interfering with the continuous operation of the landing area. More than one parking area may be needed to provide enough parking points for efficient operation of the landing strip. The following factors will affect the location of parking areas and parking points:

(1) Parking points should be separated from the active runway by a minimum of two and one-half (2 1/2) wing spans of the largest aircraft anticipated to land.

(2) Parking points within the parking area should be separated by at least two (2) airplane lengths of the largest aircraft anticipated to arrive.

(3) Parking points should be located where aircraft can enter and leave the parking area without delay.

d. Dispersal Areas. Dispersal areas are used to park disabled aircraft and other aircraft scheduled to remain in the area. Ideally, dispersal areas should afford concealment from ground and air observation and, where possible, should have ground masks between aircraft. More than one dispersal area may be required to provide the necessary aircraft dispersion.

34. ORGANIZATION AND DUTIES. For maximum efficiency, pathfinders assigned to operate a landing strip are organized into three groups: a control center, a runway party, and a parking party.

a. Control Center(CC). The CC is the pathfinder command post and communication center at a landing strip. The CC should be organized to meet the requirements of the mission (fig 2) and normally consists of the following personnel:

(1) Landing Strip Commander - Controls the operation of the landing strip and is responsible for (a) designating and marking the exact limits of the landing strip, (b) clearing and maintaining the area within his capabilities, and (c) insuring that safety procedures are observed. In certain situations he may also serve as the ground-to-air radio operator.

(2) Ground-to-Air Radio Operator - Operates the radio used to maintain air traffic control over aircraft on and around the landing strip.

(3) Pathfinder Internal Net Radio Operator - Operates the radio used to maintain communication with other elements of the section. Aids in the control of aircraft by observation and maintains a record (Appendix I) of aircraft arrivals, departures and the general types of loads carried.

(4) Additional Pathfinder Personnel - Within the control center establish I. D. codes and/or homing beacons as required. They also may be used to provide security, assist in carrying and installing equipment, and carry out other tasks as necessary.

b. Runway Party. Reconnoiters, prepares, and marks the landing area. Runway party personnel perform the following tasks:

(1) Assistant Strip Commander - Supervises marking of exact limits of the runway and the preparation and improvement of the landing area.

(2) Pathfinder Internal Net Radio Operator - Maintains communication with the control center.

(3) Other pathfinders, under the direction of the assistant strip commander:

(a) Mark the runway and remove and/or mark obstacles within their capabilities in the landing area and in the approach/departure zones.

(b) Install wind "T" or wind sock (if used).

(c) Provide local security.

(d) Install glide slope indicator (if used).

(e) Upon establishment of the landing area, perform additional duties as directed.

c. Parking Party. Reconnoiters, prepares, and marks the taxiways, parking areas, and dispersal areas. Provides parking and taxi signals for each airplane, and maintains ground communications with the CC. Parking party personnel perform the following tasks:

(1) Parking Party Commander - Directs the reconnaissance, preparation and marking of the taxiway and individual parking and dispersal points for each airplane. He controls the parking and taxi of airplanes; assists in the initial assembly of troops, equipment and supplies, if required and furnishes information to the CC concerning the type loads delivered to or taken out of the landing strip by aircraft.

(2) Pathfinder Internal Net Radio Operator - Monitors the internal net and keeps the parking party commander informed of inbound aircraft. Relays information to the CC as necessary.

(3) Signalmen - Aid in emplacing and operating visual aids and control the movement of aircraft on the ground.

d. Additional Personnel. May be attached as required to:

(1) Assist in the unloading and initial assembly of troops, equipment and supplies and to operate assembly aids as directed.

(2) Assist in preparation of runways, taxiways, parking areas, and removing or marking obstacles.

(3) Provide local security and render other assistance as directed.

35. ESTABLISHMENT OF AN AIRPLANE LANDING STRIP (Fig 11 and 12). In the establishment of the strip each element performs the following tasks:

a. Control Center. Control center radios are prepared for operation immediately upon landing. The CC party moves to its preplanned location, if not changed by actual ground reconnaissance. Ideally, the CC should be situated on terrain that permits effective communication and all around visibility of the control area. Additionallly, CC personnel compile all information necessary for transmittal to aircraft, and prepare homing beacons, smoke, light guns, and other I.D. codes, as required.

b. Runway Party.

(1) The pathfinder internal net radio is prepared for operation immediately upon arrival at the landing strip. Operators carry their radios at all times in order to maintain constant communication with the CC.

(2) The landing strip commander, with selected personnel, reconnoiters the area as soon as they arrive at the landing strip location. Following this, the strip commander selects and points out the exact location, direction, and runway alignment to the runway party, who then marks the runway with visual aids. For day operations, the runway is marked with signal panels; for night operations it is marked with lights. Generally, marking of both sides of the runway can be performed simultaneously. However, if a marking priority is required, it is established in the order of left side and then right side.

(3) Concurrently with marking, the runway party makes hasty improvement, if necessary, by filling holes or removing brush on the runway. It also removes or marks obstacles in the approach and departure zones as promptly as possible.

(4) All pathfinders should be careful not to create obstacles in the erection of antennas and the construction of field fortifications. They should keep personnel and equipment well clear of the runway and taxiways in order not to obstruct the area or distract the aviators.

c. Parking Party. The taxiways, parking areas, and dispersal areas are prepared in locations designated by the landing strip commander. The parking party prepares these areas simultaneously with preparation of the landing area. It removes or marks obstacles and continues to improve and/or maintain the facilities as long as necessary.

(1) Since the pilot sits on the left side of most airplanes, the left edge of the taxiway is outlined with panels/lights which face aviators as they taxi their aircraft.

(2) A parking point for each aircraft may be marked with a panel/light. Aircraft should be parked with the left wing over this panel/light. Parking arrangements should be preplanned and coordinated. Exercise extraordinary care in securing all panels to the ground. Use firmly driven stakes to secure panels tautly; rocks piled on the corners are not adequate.

36. OPERATION OF AN AIRPLANE LANDING STRIP.

a. General.

(1) Landing and take-offs by large numbers of aircraft may present difficult control problems for pathfinders. Radio discipline must be strictly observed to prevent interference with the exchange of messages between the CC and aviators. The CC must exercise the necessary control over aviators and signalmen, but in doing so, it must avoid transmission of unnecessary and confusing radio messages.

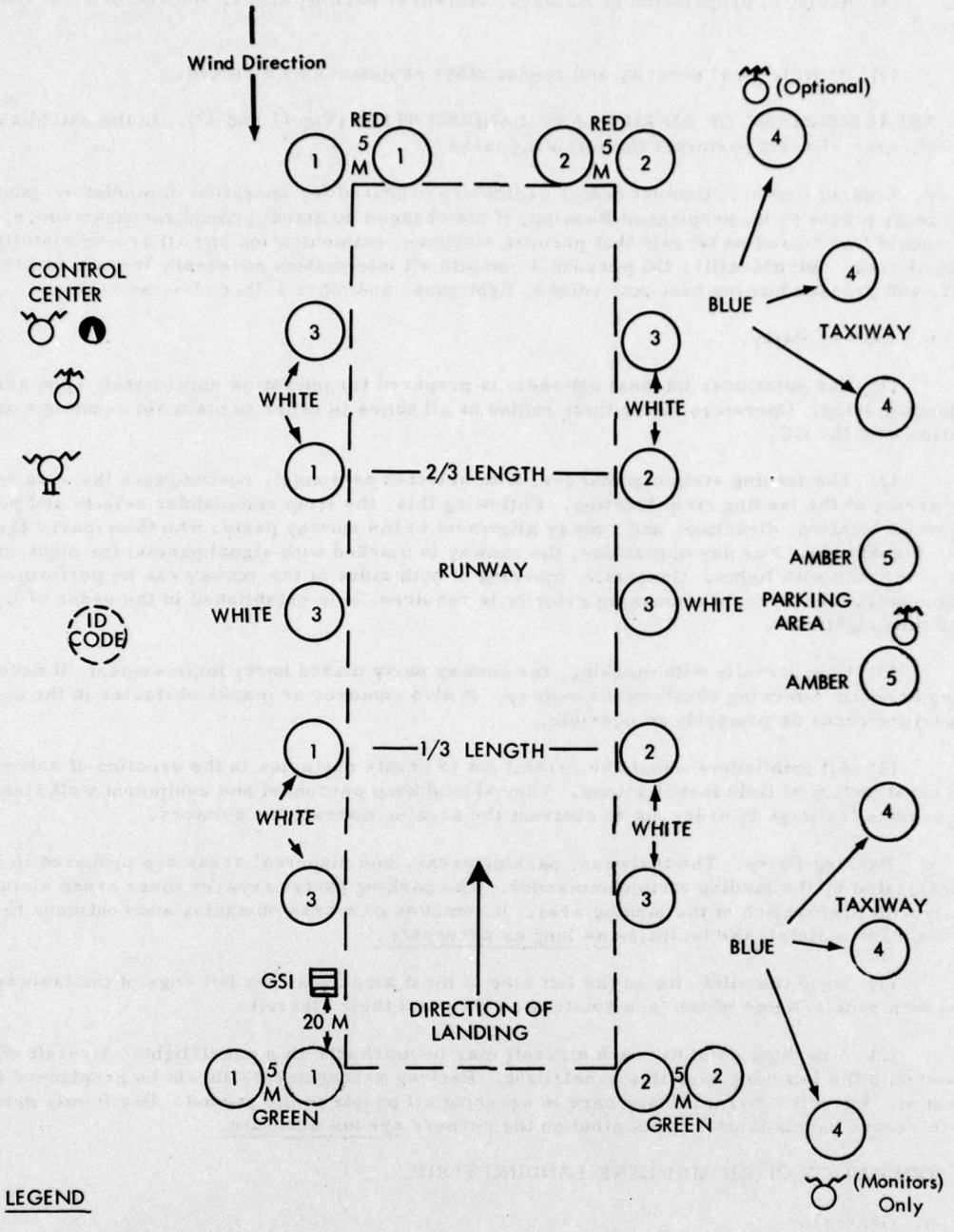


Figure 11. Airplane Landing Strip (Night)

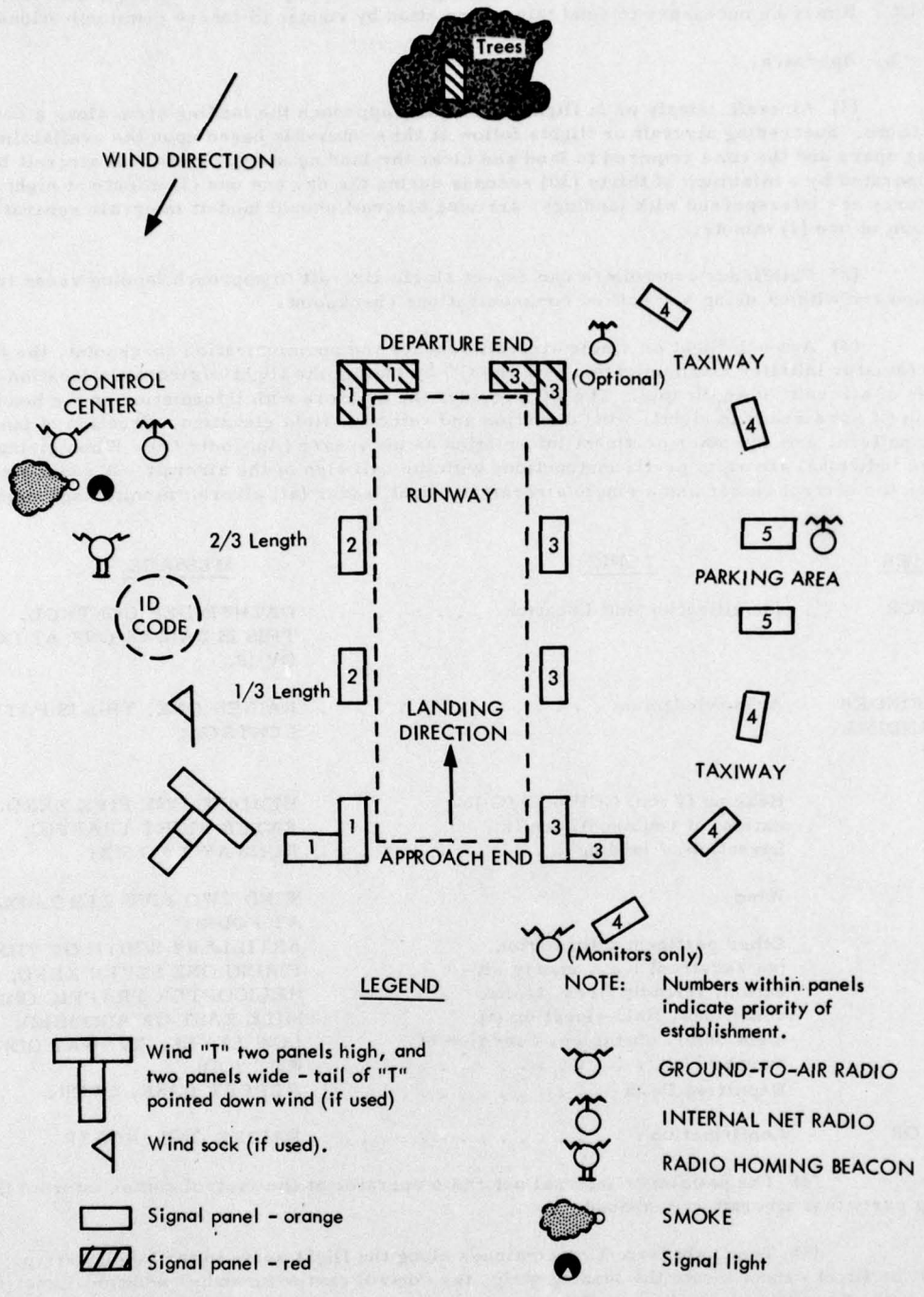


Figure 12. Airplane Landing Strip (Day).

(2) The CC pathfinder internal net operator records flight arrival and departure times and the types of loads flown in or out. The radio operator in the parking area transmits the load data to the CC. It may be necessary to send this information by runner to insure communications security.

b. Approach.

(1) Aircraft, singly or in flights, normally approach the landing strip along a designated flight route. Succeeding aircraft or flights follow at time intervals based upon the availability of parking space and the time required to land and clear the landing strip. Individual aircraft landings are separated by a minimum of thirty (30) seconds during the day and one (1) minute at night. When departures are interspersed with landings, arriving aircraft should land at intervals separated by a minimum of one (1) minute.

(2) Pathfinder controllers can expect single aircraft to approach landing areas from any direction and without using a specified communications checkpoint.

(3) As each flight or single aircraft reaches the communication checkpoint, the flight leader/aviator initiates communication with the CC by stating the flight's/aircraft's location and number of aircraft, if applicable. The CC provides the aviators with information on the heading to the airstrip (if not already in sight), wind direction and velocity, field elevation, direction of landing, traffic pattern, and any other pertinent information as necessary (Appendix IV). When giving instructions to individual aircraft, prefix instructions with the call sign of the aircraft. A radio message between the control center and a single aircraft or flight leader (all aircraft monitoring) might be as follows:

SPEAKER	TOPIC	MESSAGE
AVIATOR	Identification and Location	PATHFINDER CONTROL, THIS IS RAIDER ONE AT CCP; OVER.
PATHFINDER AT LANDING STRIP	Acknowledgment	RAIDER ONE, THIS IS PATHFINDER CONTROL;
	Heading (From CCP or A/C location, if required), traffic, Direction of landing	HEADING ONE FIVE ZERO, ENTER RIGHT TRAFFIC, RUNWAY TWO SIX;
	Wind	WIND TWO FIVE ZERO DEGREES AT FOUR;
	Other pertinent Information (as required) i.e., enemy situation, friendly fires, traffic conditions, field elevation (at night only), obstacles, condition of runway	ARTILLERY SOUTH OF THE STRIP FIRING ONE SEVEN ZERO, HEAVY HELICOPTER TRAFFIC ONE MILE EAST OF AIRFIELD, LOW LEVEL, RUNWAY CONDITION WET SOD;
	Reporting Point	REPORT BASE, OVER.
AVIATOR	Confirmation	RAIDER ONE, ROGER.

(4) The pathfinder internal net radio operator at the control center informs the parking party that aircraft are inbound.

(5) The flight formation continues along the flight route to the landing strip. If an aircraft or flight cannot locate the landing strip, the control center furnishes additional assistance on request. When the flight of aircraft approach the landing strip, the flight leader designates the order of landing, or if prearranged, insures that the aircraft land in the designated sequence. Each pilot notifies the CC when his aircraft commences its turn to base/final leg. Messages transmitted might be as follows:

SPEAKER	TOPIC	MESSAGE
AVIATOR	Location	PATHFINDER CONTROL, RAIDER ONE, TURNING RIGHT BASE.
PATHFINDER	Acknowledgment	RAIDER ONE, PATHFINDER CONTROL,
	Wind	WIND TWO FIVE ZERO DEGREES AT FIVE;
	Clearance	CLEAR TO LAND;
	Parking Instructions	TURN RIGHT END OF RUNWAY
AVIATOR	Confirmation	RAIDER ONE, ROGER, OUT.

c. Landing. Each aircraft lands as directed by the control center and the displayed visual aids.

(1) Visual signals are used in accordance with prearranged plans to assist aviators in routine landings and in emergency situations. If ground-to-air communication fails, landings and take-offs are controlled by means of visual signals and aids. (Appendix IV).

(2) Care must be taken not to blind the aviators with smoke or confuse them with unnecessary or unusual signals.

(3) If a situation arises that would endanger the aircraft or make landings hazardous, the pathfinder air traffic controller should keep all airplanes in the air until the landings can be safely accomplished. In the case of enemy action around the airfield, it may be necessary to clear all airborne aircraft from the immediate area temporarily. The controller instructs the aviators by ground-to-air radio and/or emergency visual signals.

d. Parking. As each aircraft touches down, the parking party assumes control.

(1) A signalman guides the aircraft from the runway to the taxiway. The aircraft then taxis to the parking area by guiding on the visual aids displayed. On exceptionally rough or unmarked taxiways, it may be necessary for a signalman to lead each aircraft to its parking area.

(2) As each aircraft enters the parking area, a signalman directs it to its designated parking point.

(3) All parking, taxi, and arm and hand signals (Appendix V) must be clearly visible (at night lighted batons or flashlights are used) and understandable to aviators. These signals are given from the left front of the airplane. Signalmen must be positioned far enough from the airplane to be in view of the pilot.

(4) When an aircraft has parked, designated personnel from the supported unit take charge of the unloading and initial assembly of the supported troops, equipment or supplies. Movement and assembly must be performed rapidly and in such a manner that the runway, taxiways, or parking points will not be blocked. Movement across the runway is not permitted without specific approval of the CC.

(5) Disabled aircraft and aircraft unable to leave on schedule should be moved to a dispersal area if interference with operations is anticipated.

e. Departing. When aircraft are ready to depart, the aviator requests taxi instructions from the pathfinder air traffic controller at the CC. Signalmen may be used to guide the aircraft out of the parking area, and along the taxiway, to a point short of the active runway, (the "hold position", two airplane lengths from the active runway). When aircraft are ready for take-off, the aviator will request take-off instructions. A departure may be made in a full flight formation, in portion of a flight formation, or by individual aircraft, depending upon the plan and the existing situation. A message sequence might be as follows:

SPEAKER	TOPIC	MESSAGE
AVIATOR	Taxi Instructions	PATHFINDER CONTROL, RAIDER ONE, REQUEST TAXI INSTRUCTIONS.
PATHFINDER	Taxi Instructions	RAIDER ONE, PATHFINDER CONTROL; WIND TWO ZERO ZERO DEGREES AT FOUR, CLEAR TO TAXI FOR RUNWAY TWO SIX HOLD SHORT OF ACTIVE RUNWAY, CALL FOR TAKE-OFF.
AVIATOR	Confirmation	RAIDER ONE, ROGER.
AVIATOR (HOLD POSITION)	Take-off Instructions	PATHFINDER CONTROL, RAIDER ONE, READY FOR TAKE-OFF.
PATHFINDER	Take-Off Instructions	RAIDER ONE, PATHFINDER CONTROL; WIND TWO ZERO ZERO DEGREES AT FOUR, CLEAR FOR TAKE-OFF.
AVIATOR	Confirmation	RAIDER ONE, ROGER, OUT.

f. Helicopter Traffic.

(1) General. In most tactical situations airfield controllers can anticipate a large volume of helicopter traffic. They may arrive as single aircraft or as flights. Whenever possible, helicopter landing areas should be planned to expedite traffic and avoid helicopter interference with the operation and safety of the active runway, taxiways, and parking areas.

(2) Selection of Helicopter Landing Areas: Helicopter landing areas should be coordinated with the supported or using aviation unit. Consideration must be given to the type helicopters and the purpose for the landing area (i.e., medical facilities, rearming/refueling points, troop loading/unloading areas and resupply points). The terrain will dictate the size and exact location of these landing areas.

(3) Marking Helicopter Landing Areas:

(a) If specific markings are used to designate helicopter landing areas, they will normally be determined by the supported or using aviation unit, and coordinated with the pathfinder site commander.

(b) When special markings are not required, landing areas may be designated by the use of a reference point (i.e., terrain features, relation to the active runway, etc.) Other aids that are used to mark landing areas include signal panels, lights, and smoke. Helicopters should not be allowed to hover near or land directly on signal panels. Lights may mark the landing area and, if coordinated, arranged to accommodate the exact number and landing formation of the inbound aircraft. When using smoke, care must be taken to insure that its use will not mask any portion of the landing strip. Signalmen are normally not required at this type helicopter landing site.

(4) Control of Helicopter Traffic:

(a) Inbound helicopters can be controlled by directing the flight to enter the established traffic pattern. When in the traffic pattern, standard procedures will be followed. However, care must be exercised to insure that the speeds of the helicopters are approximately the same as that of the airplane traffic. Preferably, helicopters should not land on, or hover over, the active runway, but be directed to fly a final approach parallel to the active runway and directly to their landing area.

(b) Helicopters may also be allowed to proceed directly to their designated landing areas without entering the traffic pattern. The information given helicopters directing them to their landing area should insure that they do not present hazards or delays to existing airplane traffic. In this case, helicopters normally approach and depart their landing areas at altitudes well under the established traffic pattern.

(c) Parking within the landing strip will conform to exisiting safety regulations pertaining to the type helicopter, terrain, or mission. If possible, helicopters should be parked so that the aviator is able to observe the active runway. NOTE: Armed helicopters should be parked in such a manner that the weapon systems do not present a hazard to any personnel concentrations, parked aircraft, or facilities at the landing strip.

(d) When departing, singly or in flights of aircraft, aviators request permission from the pathfinder air traffic controller. Helicopters may take-off in any direction, consistent with safety requirements, in order to expedite air traffic. Clearance to take-off may be given to helicopters and airplanes concurrently provided the terrain and situation permit.

CHAPTER 6

DROP ZONES

37. GENERAL. A drop zone (DZ) is an area where troops or material are delivered by parachute, or, in the case of certain items, by free drop.

38. SECTION CAPABILITIES, ORGANIZATION AND DUTIES.

a. A pathfinder section is organized and equipped to operate three day or night drop zones simultaneously.

b. The pathfinder section is organized to provide a control center (CC) and a marking party for each drop zone. The marking party is further subdivided to prepare and place the panels (lanterns) that form the code letter; the flank panel (lantern and signal light) and far panel (lantern and signal light), respectively; and provide limited security and establish assembly aids, if required.

c. The CC is organized and operated as described in Chapter 3. A release point may be established if deemed necessary by the supported aviation unit.

39. SELECTION OF A DROP ZONE.

a. A drop zone is located where it can best support the ground tactical plan. Factors to be considered in its selection are:

(1) Type aircraft employed.

(2) Altitude at which air delivery is to be made.

(3) Types of loads to be delivered.

(4) Relative number of obstacles in the area.

(5) Availability of adequate aircraft approach and departure routes.

(6) Method of air drop, i.e., free drop, high velocity, or low velocity.

(7) Access to the area.

b. The required length of a drop zone can be computed by using the ground speed of the aircraft and the time needed to release its cargo. The formula is D equals RT. D is the zone length (distance) in meters, R is the ground speed (rate) of the aircraft in meters per second, and T is the time required for an aircraft to release its cargo. To use this formula, air speed (expressed in knots) must first be converted to ground speed (expressed in meters per second).

NOTE: When the wind velocity at the delivery altitude cannot be determined, use the aircraft's air speed as the ground speed.

(1) To compute the ground speed when an aircraft is flying into a headwind, subtract the velocity of the headwind from the air speed. For example, an aircraft flying into a 10-knot headwind at an indicated air speed of 110 knots will have a ground speed of 100 knots. To compute the ground speed when an aircraft is flying with a tailwind, add the velocity of the tailwind to the air speed. For example, a 10-knot tailwind plus a 110-knot air speed gives a ground speed of 120 knots.

NOTE: It is desirable to fly aircraft into the wind during air delivery because the slower ground speed gives more time over the zone and assures a more compact delivery pattern.

(2) To convert knots to meters per second, use the following equation: 1 knot equals 0.51 meters per second. Thus, a ground speed of 100 knots equals 0.51 X 100 or 51 meters per second.

(3) To calculate the required length of a DZ by using the formula D equals RT and applying the conversions described in (1) and (2) above, proceed as in the following example: An aircraft is flying at a ground speed of 90 knots, and its cargo can be released in 8 seconds. What is the required length of the DZ?

R equals 45.9 meters per second (0.51 X 90 equals 45.9).
T equals 8 seconds.
D equals 45.9 X 8 367.2 meters (rounded up to 368 M).

c. If a DZ of the desired length is not available, the flight time over the zone (whatever its length) must be computed to determine how much of the load can be released in one pass and/or how many passes must be made to release the entire load. The following formula is used: T equals $\frac{D}{R}$, in which T is the time over the DZ, D is the length (distance) of the DZ, and R is the ground speed (rate). For example, a field 150 meters long is available as a DZ, and an aircraft can release its load at a ground speed of 105 knots or 54 meters per second (0.51 X 105 equals 53.55 or 54). Applying the formula T equals $\frac{D}{R}$, 150 divided by 54 equals 2.7 seconds which is the time over the DZ. This figure is then rounded down to the next lower whole second (2.0) to allow for slight delays in initiating the drop.

d. The required width of the DZ depends upon the method and/or type of air drop, wind drift, and formation of the aircraft. When using a relatively narrow or small drop zone, it may be necessary to locate the CC (the point over which the drop is initiated) off the actual drop zone to allow for calculated wind drift.

40. LOCATION OF CODE LETTER.

a. General. The location of the code letter depends upon the size and shape of the DZ; the formation, ground speed, and altitude of the aircraft over the DZ; and the drift of parachuted loads which, in turn, depends upon the direction and velocity of the wind. The code letter is alined with the long axis of the DZ or on a prearranged azimuth. The aircraft fly over the code letter and begin releasing their loads as they come on line with the flank panel. The exact code letter used should be prearranged and coordinated. Code letters will normally be prescribed by unit SOI.

b. Wind Drift Formula. The wind drift formula, D equals KAV, is used to determine the amount of drift of parachutes (in meters) from a given altitude. In this formula, K is a constant that represents the characteristic drift of a parachute of a certain model (for all personnel parachutes, K is 4.1; for all other parachutes, K is 2.6), A is the actual drop altitude of the aircraft (in hundreds of feet) over the DZ, and V is the velocity (in knots) of the surface wind.

(1) An anemometer can be used to measure wind velocity. Some anemometers give readings in knots, and others in miles per hour. Miles per hour is divided by 1.15 to convert to knots, but, for practical purposes, the direct substitution of miles per hour for knots in the wind drift formula gives sufficiently accurate results for winds below 10 knots.

(2) Since each pathfinder will not always have an anemometer available, he must be able to estimate wind velocity with acceptable accuracy. Pathfinders can learn to do this during training by observing the effect of winds of varying strengths on grass, dust, bushes, or small pieces of paper, and then comparing these effects with anemometer readings. (For expedient methods of determining wind velocities, see FM 23-71.)

(3) To illustrate how the wind drift formula (D equals KAV) is applied, assume that G-13 parachutes are used to drop cargo from an actual altitude of 500 feet in a 10 knot surface wind. Wind drift, then, equals 2.6 x 5 x 10 or 130 meters.

41. ESTABLISHMENT OF A DROP ZONE.

a. Day Drop Zone (Fig. 13).

(1) The pathfinder site commander selects the exact location for the code letter. He then has the code letter alined on the heading which he desires the aircraft to fly over the drop zone. The assistant site commander supervises the placement of the code letter.

(a) The marking party places the code letter on the ground as shown in Figure 13 and elevates the top of the code letter for increased long range visibility.

(b) The flank panel is established parallel to the code letter, alining the top of the flank panel with the top of the code letter or base panel. The flank panel is placed 200 meters from the left edge of the code letter or at the edge of the DZ, whichever is less.

(c) The far panel is established a maximum distance of 500 meters from the code letter or at the end of the drop zone, whichever is less. The far panel will be placed on the desired drop heading, with the panel elevated and in line with the base panel of the code letter.

(2) Concurrently, the CC prepares the ground-to-air radio and electronic homing beacon (if used) for operation. All electronic aids must be sufficiently separated to prevent mutual electronic interference or simultaneous loss by enemy fire.

b. Night Drop Zone (Fig. 13). The procedure for establishing a night DZ is the same as for a day DZ except incandescent lights (or field expedients) are used to mark the code letter, the flank, and the far end of the drop zone. The code letter should be a minimum of four lights high, three lights wide, with five meters between lights. Signal lights are located at the CC, flank and far panel.

c. Detecting DZ's. In heavily vegetated terrain, DZ's may be difficult to locate from the air. Electronic homing beacons are especially useful in such terrain. Expedient methods such as balloons and pyrotechnics may also be used to assist aircraft in locating and identifying DZ's. In situations where secrecy is of prime importance, aircraft equipped with automatic direction finding (ADF) equipment can conduct drops using only the radio homing beacon, without the aid of radio control or visual markings.

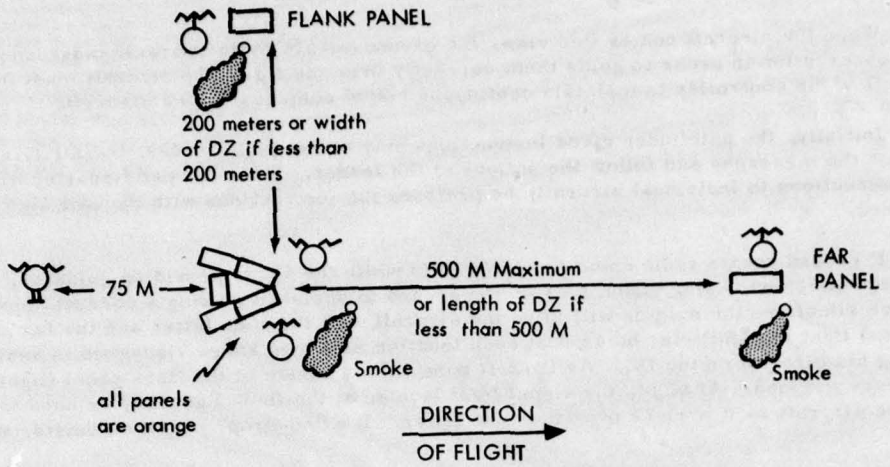
42. OPERATION OF A DROP ZONE.

a. Aircraft may approach the DZ either as single aircraft or in flights. As a single aircraft or flight reaches the communication checkpoint, the pilot or flight leader informs the CC of his position and includes additional information, as necessary, concerning the number and type(s) of aircraft and types of loads. The CC provides the aviators the magnetic heading (vector) from the communication checkpoint to the DZ, drop altitude (indicated), and any other pertinent information necessary. The altitude (indicated) prescribed for the aviators by the CC must be high enough to guarantee adequate clearance of all obstacles in the flight path. The flight leader acknowledges receipt of the message and complies with the instructions received.

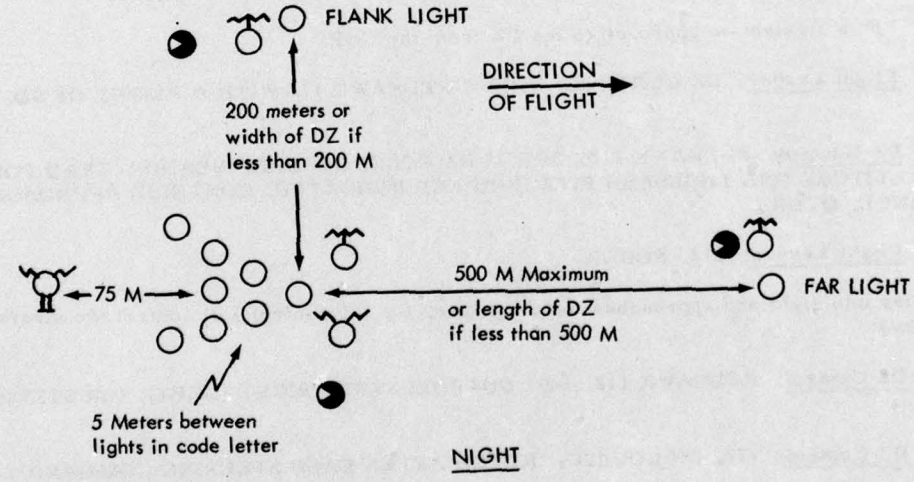
b. In certain areas, long range visibility may be restricted by tall trees. When dropping in such areas at altitudes of 500 feet (actual) or less, it may be necessary for the pathfinder to require the drop aircraft to maintain a higher altitude enroute from the CCP to allow for establishment of long range visual contact. The aircraft is then directed to descend to the prescribed drop altitude at the proper time to allow a safe approach and correct delivery.

c. As the lead aircraft comes into view, the CC gives the aviator verbal instructions to guide the aircraft over the code letter, alerts him as he nears it, and directs him when to release his load. Trailing aircraft follow the movements of the lead aircraft as closely as possible and listen for corrective instructions from the CC.

d. In an extremely restricted DZ, it may be necessary for each aircraft to make several passes, releasing a part of its load on each pass. The only formation flown in this situation is single aircraft in trail. The CC directs the aircraft to fly over the DZ in a continuous "racetrack", using either a left or right-hand traffic pattern (Appendix IV). Since the aviators of aircraft in trail can usually follow the lead aircraft quite accurately, the CC seldom has to give individual instructions until shortly before each aircraft is in position to drop its load.



DAY



NIGHT

NOTE: White lights are preferable; blue or green lights are difficult to detect from range.

NOTE: See Figures 11 & 12 for symbol legend

Figure 13. Day and Night Drop Zone.

43. EXAMPLES OF DROP ZONE GUIDANCE PROCEDURE.

a. General.

(1) When the aircraft comes into view, the ground-to-air radio operator must keep them under constant observation in order to guide them correctly over the DZ. The aircraft must be flying high enough to allow the controller to maintain continuous visual contact with the aircraft.

(2) Initially, the pathfinder gives instructions only to the flight leader, but all aviators in the flight monitor the messages and follow the actions of the leader. When the pathfinder controller needs to give instructions to individual aircraft, he prefaces the instructions with the call sign of the aircraft concerned.

(3) If ground-to-air radio communication fails while the CC is providing guidance, all aviators continue their missions, using visual aids on the ground to assist in making a correct approach and delivery. In such situations the aviator will aline the aircraft with the code letter and the far panel. Smoke (or a signal light at night) may be used at each location as a long range visual aid to assist the aviator in alining his aircraft on the DZ. As the left wing comes abeam of the flank panel (light), the aviator will release the load. At night, the signal light located at the flank light may be used to flash the drop signal to the aircraft as it arrives over the code letter. If a "no-drop" condition exists, the CC will:

(a) Transmit a verbal "no drop" (repeated at least three times) to the aircraft over the ground-to-air radio.

(b) Display red side of panels during day operations, time permitting.

(c) Display no visual aids (day or night), time permitting.

(d) Use precoordinated visual signals, to include pyrotechnics or lights.

b. Guidance for a Drop. Guidance procedures for a drop might be as follows:

(1) For a straight-in approach to the DZ from the CCP:

Flight Leader: DZ CONTROL, THIS IS REDHAWK 112 WITH A FLIGHT OF SIX AT CCP, OVER.

DZ Control: REDHAWK 112, THIS IS DZ CONTROL; DROP HEADING ZERO FOUR FIVE, DROP ALTITUDE ONE THOUSAND FIVE HUNDRED INDICATED, CONTINUE APPROACH FOR VISUAL GUIDANCE, OVER.

Flight Leader: 112, ROGER.

As aircraft comes into sight and approaches the drop zone, the DZ control will contact the aircraft and proceed as follows:

DZ Control: REDHAWK 112, DZ CONTROL; STEER RIGHT (LEFT), (OR STEER HARD RIGHT/LEFT).

DZ Control: 112, ON COURSE. (GIVEN AFTER EACH STEERING COMMAND.)

DZ Control: 112, STAND BY. (GIVEN FROM FIVE TO TEN SECONDS BEFORE THE DROP SHOULD COMMENCE)

DZ Control: 112, EXECUTE! EXECUTE! EXECUTE!

NOTE: The flight leader will execute the air delivery, and will maintain his drop heading until he clears the drop zone. Should other aircraft in the flight veer off the desired course prior to or during the drop, individual steering commands can be given. Each aircraft will be given "stand by" and the command to drop by the CC. The command of "execute" is given until a response is seen

or conditions are no longer safe to drop. The command "no drop" will be given by the CC when an unsafe condition exists on the drop zone or the aircraft is improperly alined over the code letter to the degree that the load would not land on the DZ.

(2) For approach to the DZ other than straight-in from CCP.

Aviator: DZ CONTROL, THIS IS REDHAWK 220 AT CCP, OVER.

DZ Control: REDHAWK 220, THIS IS DZ CONTROL; HEADING ZERO FOUR FIVE, DROP ALTITUDE SEVEN HUNDRED INDICATED, MAINTAIN ONE THOUSAND FIVE HUNDRED INDICATED UNTIL I HAVE YOU IN SIGHT, OVER.

Aviator: REDHAWK 220, ROGER.

As aircraft comes into sight and approaches the required drop heading, the CC will contact the aircraft and proceed as follows:

DZ Control: REDHAWK 220, DZ CONTROL; TURN LEFT TO HEADING THREE SIX ZERO, DESCEND TO SEVEN HUNDRED INDICATED.

Aviator: 220, ROGER.

DZ Control: 220, STEER RIGHT (LEFT), (OR STEER HARD RIGHT/LEFT).

DZ Control: 220, ON COURSE (GIVEN AFTER EACH STEERING COMMAND).

DZ Control: 220, STAND BY.

DZ Control: 220, EXECUTE! EXECUTE! EXECUTE!

(3) For a drop utilizing a traffic pattern:

Aviator: DZ CONTROL, THIS IS REDHAWK 178 AT CCP, OVER.

DZ Control: REDHAWK 178, THIS IS DZ CONTROL; HEADING ZERO FOUR FIVE, DROP ALTITUDE ONE FIVE FIVE ZERO INDICATED, TWO BUNDLES PER PASS, CONTINUE APPROACH FOR VISUAL GUIDANCE, OVER.

Aviator: REDHAWK 178, ROGER.

As aircraft comes into sight and approaches the required drop heading, the DZ control will contact the aircraft and proceed with the following:

DZ Control: REDHAWK 178, DZ CONTROL; TURN LEFT TO HEADING ZERO ONE ZERO.

Aviator: 178, ROGER.

DZ Control: 178, STEER LEFT (RIGHT).

DZ Control: 178, ON COURSE (GIVEN AFTER EACH STEERING COMMAND).

DZ Control: 178, STAND BY.

DZ Control: 178, EXECUTE, EXECUTE, EXECUTE, --ENTER LEFT (RIGHT) TRAFFIC, REPORT FINAL.

Aviator: 178, ROGER.

CHAPTER 7

LOW LEVEL EXTRACTION (LOLEX) ZONES

44. GENERAL. A low level extraction (LOLEX) zone is an area where material can be delivered from aircraft at an altitude of 15 feet or less by means of an extraction parachute attached to a palletized load.

45. UNIT ORGANIZATION AND DUTIES. To operate a LOLEX zone, pathfinders are organized into a CC party and a marking party. A release point (RP) may be established if deemed necessary by the supported aviation unit.

a. Control Center and Release Point. A control center (CC) is required at each LOLEX zone. If a pathfinder section operates more than one zone, the pathfinder unit commander should be located at the most important site. The CC and RP (if manned) are organized and operated as described in Chapter 3.

b. Marking Party. The marking party reconnoiters, prepares, and marks the LOLEX zone with panels as shown in Figure 14. The marking party also provides limited security, and removes and/or marks obstacles on the approach and departure ends of the LOLEX zone.

46. SELECTION OF A LOLEX ZONE.

a. A LOLEX zone is located where it can best support the ground tactical plan. Factors to be considered in its selection are:

(1) Type aircraft to be used (normally CV-2).

(2) Type of loads to be delivered.

(3) Type of extraction parachute to be used.

(4) Relative number of unremovable obstacles in the area.

(5) Required length and width of extraction area.

(6) Availability of adequate aircraft approach and departure routes.

(7) Access to the area.

(8) Personnel and facilities available for clearing delivered pallets from the site.

b. The required length of an extraction zone should be coordinated with the aviation unit concerned. Normally, the distance required to complete an extraction is 200 meters at 90 knots drop speed. If possible, the extraction should be executed into the wind.

47. ESTABLISHMENT OF A LOLEX ZONE.

a. Day LOLEX Zone.

(1) The ground-to-air radio, pathfinder internal net radios, and homing beacons (if used) are prepared for operation immediately upon landing. Operators carry their radios at all times in order to maintain constant communications.

(2) The marking party reconnoiters the zone immediately upon arrival. Based on this reconnaissance, the site commander selects the execution point and designates the line of flight.

(3) The marking party alines and emplaces the panels on the designated line of flight. Concurrently with marking the LOLEX zone, the marking party marks and/or removes obstacles on the approach and departure ends.

(4) Because of the extreme low level flight of the aircraft, pathfinders should insure that personnel, antennas and other equipment do not present a hazard to the incoming aircraft. Equipment and unnecessary personnel must be kept clear of the extraction area. Pathfinders must insure that any smoke used does not mask the line of flight.

b. Night LOLEX Zone. At this time, a safe method of conducting LOLEX operations at night has not been developed. Several procedures are currently under study by appropriate agencies.

48. OPERATION OF A LOLEX ZONE.

a. Guidance instructions and air traffic control procedures are practically identical for LOLEX and paradrop operations. The main differences are that delivery aircraft normally must be checked to insure that landing gear is down; and vertical steering commands may be required to bring the aircraft cargo compartment to within the required distance above the ground for correct delivery.

b. In certain situations, a LOLEX may be made with aircraft landing gear retracted; i.e., when using rough delivery areas. This method may be hazardous, however, and should only be attempted by experienced aviators in unusual situations.

c. If facilities or personnel are not available to remove pallets from the delivery area between passes, the CC will direct succeeding approaches to insure that low passes and subsequent extractions are not made over previously delivered pallets.

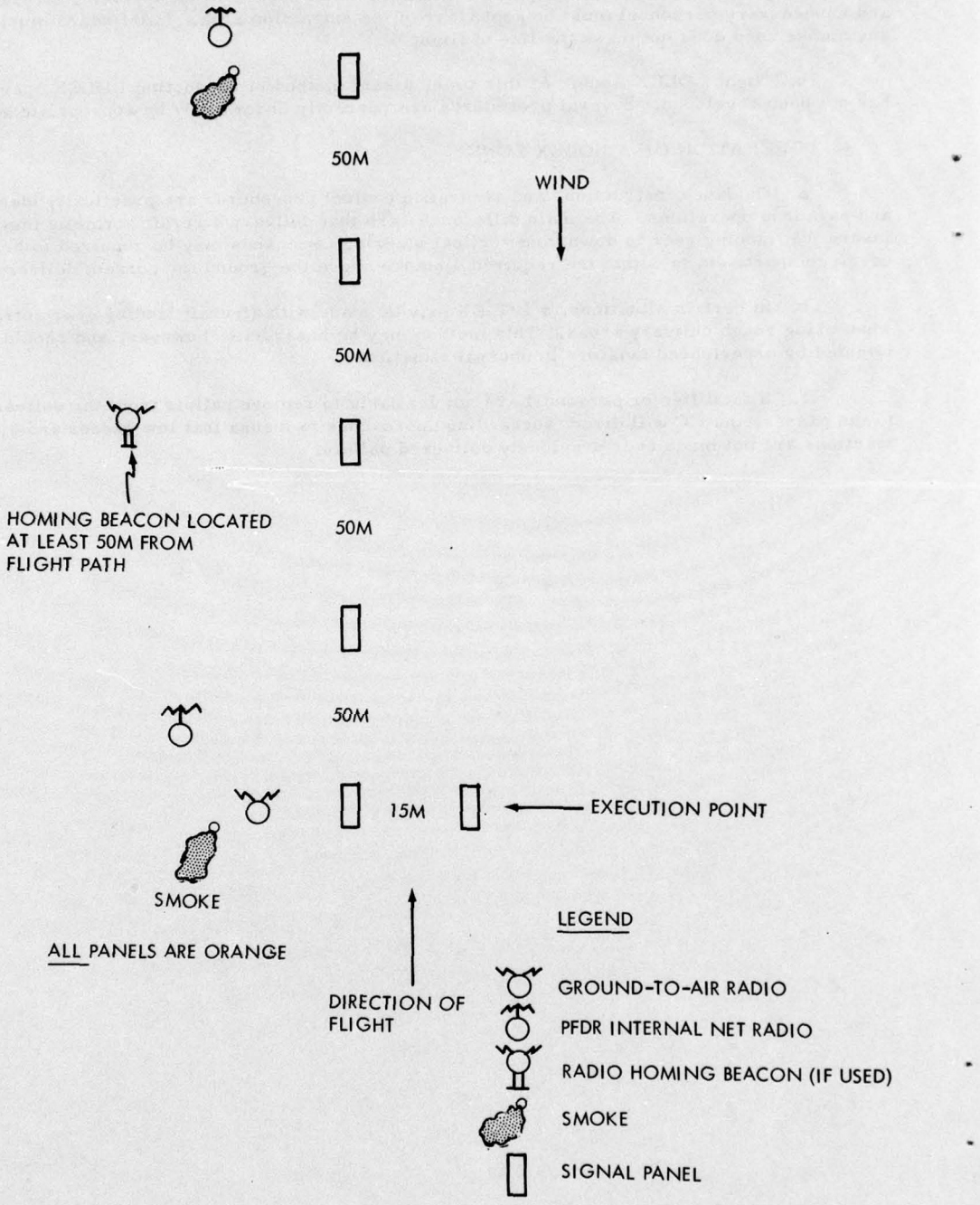


FIGURE 14. Day Low Level Extraction (LOLEX) Zone

APPENDIX I

OPERATION FORMAT

1. GENERAL. The formats described herein may be used to facilitate planning and accomplishment of pathfinder operations. These formats are intended as a guide and should be modified as required.

2. OPERATION PLANNING FORMAT.

a. Purpose. This format (Fig 15) is used by the pathfinder commander in organizing his unit for an operation. It consolidates information pertinent to each individual or element and can be used as a reference by the commander during his planning and briefing for an operation.

b. Explanation of Headings.

(1) Aircraft number. The chalk number or the last three digits of the tail number of the aircraft in which the individual will be transported.

(2) Name. The name of the pathfinder.

(3) Load time. The time the pathfinder must be loaded on the aircraft with all his equipment.

(4) T/O time. The takeoff time is when the aircraft will depart the staging area.

(5) Duty and location. The job assignment and location within the operational area for each pathfinder.

(6) Call sign and freq. The radio call sign and frequency for those individuals operating radios.

(7) Equipment. Equipment, other than individual equipment, that each pathfinder element will carry for the operation.

(8) Remarks. Any other pertinent information necessary.

3. LANDING AND/OR DROP ZONE CONTROL RECORDS.

a. Purpose. This format (Fig 16) may be used to maintain a record of aircraft arrivals, departures, and type loads. It serves as a source of information for both ground and aviation commanders, aids in accounting for personnel and equipment, and may be instrumental in initiating or assisting in search and rescue operations for overdue or downed aircraft. It is normally maintained by the pathfinder internal net radio operator at the CC.

b. Explanation of Headings.

(1) Format heading.

(a) Pathfinder unit. Coded or number designation.

(b) Supported unit. Principal ground unit or aviation unit designation.

(c) Period. Date and time operation commences until termination of operation or end of the day; 0001 until 2400 hours on succeeding days or until completion of operation.

(d) Operation. Name or number of operation.

(e) LZ, Afld, DZ. Cross out items not applicable and add any special designation used.

(f) Recorder. Name of person who has recorded data on the form.

(2) Column headings:

(a) Flight or aircraft number. Radio call sign of the flight or aircraft.

(b) Type aircraft. Army or Air Force model designation.

(c) Time communication established. Time aircraft acknowledges contact (radio or visual, as applicable).

(d) Time.

1. Arrival. Time aircraft or first of flight lands.

2. Departure. Time aircraft or last of flight has wheels up.

(e) Type load.

1. Delivered. Supplies, equipment, or personnel delivered.

2. Evacuated. Supplies, equipment, or personnel evacuated.

(CLASSIFICATION)

PATHFINDER OPERATION PLANNING FORMAT

ACFT NO	NAME	LOAD TIME	T/O TIME	DUTY AND LOCATION	CALL SIGN & FREQ	EQUIPMENT	REMARKS
N/A	Gillem	N/A	N/A	Section CO, Stage Fld Dekkar Strip, GL 934730	Blackhat 6, 34.50	4 - PRC/25 radios 24 - VS/17 panels 35 - MX/290 lanterns 3 sets of batons	Be prepared for mixed traffic and night opns until relieved.
"	Caro	"	"	G/A RTO, Stage Fld	Dekkar Control, 34.50		
"	Gurley	"	"	Int net RTO, Stage Fld	CC, 66.20	1 - SE/11 light gun 1 - ML/433 anemometer	Homing beacon freq 1750KC
"	Greene	"	"	Signalman, Stage Fld	Park, 66.20	3 colored jackets Extra smoke	
"	Cranfield	"	"	Signalman, Stage Fld	Hot Spot, 66.20		
750	Fullerton	0540	0545	Site CO, LZ Albany GL 055713	Blackhat 1, 40.20	2 - PRC/25 radios 12 - MX/290 lanterns 1 - SE/11 light gun 1 set of batons 6 - VS/17 panels 1 - ML/433 anemometer	Accompany A/1-188th on search & destroy operation until completed.
"	Clarey	"	"	G/A RTO, LZ Albany	Albany Control, 40.20		
"	Dixon	"	"	Pfdr, LZ Albany	N/A		
777	Henderson	0535	0540	Site CO, LZ Macon GL 075720	Blackhat 2, 51.30	8 smoke greandes	Accompany B/1-188th on search and destroy operation until completed.
"	Moore	"	"	G/A RTO, LZ Macon	*Macon Control, 51.30*	*Same as for* LZ Albany	
"	Redmond	"	"	Pfdr, LZ Macon	N/A		
	Hoffman	N/A	N/A	Site CO, Standby Reserve Vic Dekkar Strip	Blackhat 3, 37.30		Remain with C/1-188th (Reserve) at Dekkar Strip; Commited on order.
"	Welch	"	"	G/A RTO, Standby Reserve	37.30*	Same as for LZ Albany	*Call sign will correspond with name of landing site if reserve is committed.
"	Murray	"	"	Pfdr, Standby Reserve	N/A		
N/A	Thomas	"	"	R&R			

Supported Unit: 1-188th Inf.
Lift Unit: A/21st Avn Bn
ACL: 8 PAX
LZ Time: 31 0600 Mar
DAGO: S3 Air, 1-188th Inf, Dekkar Strip

Type Acft: UH-1D
Arty prep at LZ Macon & Albany commences H-20 min; lifted H-5 min
Arty prep fired from GL 035725
CCP: GL 956696
RP: GL 015692

SIGNAL
1-188th Inf: Right Half, 47.00
A/21st Avn Bn: Deadly Serpent, 39.00
Pathfinders: Dekkar Control, 34.50
Albany Control, 40.20
Macon Control, 51.30
Reserve, 37.30

(CLASSIFICATION)

Figure 15. Operations Planning Format.

Pathfinder Unit: 21st Avn Bn Pfdr Sect
Supported Unit: 1-188th Inf
Period: 210001-212400 March __
Operation: (Afld, LZ, DZ) MASHER
(Name or Location of Site)
Recorder: PFC Roy S. Cobb

FLT OR ACFT NO	TYPE ACFT	TIME COMM ESTAB	TIME ARR	TIME DPRT	TYPE LOAD DELIVERED	TYPE LOAD EVAC	REMARKS
(Example for airfield operation)							
Muddy 750	CV-2	0600	0610	0625	Rations	2WIA	
Muddy 882	CV-2	0605	0615		Ammunition		Damaged propeller; to dispersal area.
Muddy 123	CV-2	0610	0620	0635	Ammunition	4WIA	
(Example for drop zone operation)							
Muddy 111	CV-2	1705	1710		3 Bundles-Ammo		
Muddy 334	CV-2	1715	N/A				Aborted two miles out.
Muddy 678	CV-2	1720	1725		3 Bundles-Rations		
(Example for helicopter landing site operation)							
Yellow 1	UH-1D	1230	1235	1236	Personnel		Contacted CC with a flight of four
Yellow 2	UH-1D	1230	1235	1236	Personnel		
Yellow 3	UH-1D	1230	1235	1236	Personnel	4WIA	
Yellow 4	UH-1D	1230	1235	1236	Mortar Ammo		
Panther 167	CH-47	1245	1250	1252	Ammunition		
Apache 921	CH-54	1300	1305	1307	N/A	1 UH-1D	

Figure 16. Landing and/or Drop Zone Control Record.
(Sample Extract)

APPENDIX II

CHECKLIST FOR PATHFINDER OPERATIONS

Upon receipt of an order to conduct a pathfinder operation, the pathfinder commander follows, to the extent possible, the troop leading procedures listed below:

a. Issue section warning order to include:
   (1) A brief statement of the enemy and friendly situation.
   (2) Mission of the section.
   (3) Uniform and individual equipment; team and special equipment.
   (4) Work priority for preparation of team equipment. (Normally SOP)
   (5) Issue of rations, ammo, and special equipment.
   (6) Breakdown of section personnel.
   (7) Time and place for the section to receive the operations order.

b. Make tentative plan of operation to include the following:
   (1) Study map.
   (2) Check weather.
   (3) Study unit SOI.
   (4) Make a quick estimate of the situation.
      (a) Necessity for additional personnel from supported unit.
      (b) Necessity for additional equipment or material.
      (c) Communications requirements.
   (5) Begin planning.

c. Arrange for:
   (1) Movement of unit (informs second in command).
   (2) Coordination (with ground and aviation units).
      (a) Ground tactical plan.
      (b) Landing and unloading plan.
      (c) Air movement plan.
      (d) Loading plan.
   (3) Additional personnel or equipment, if any, from supported units.

d. From the above, prepare tentative operational plan for the pathfinder section.

e. Make reconnaissance when time permits. Continue estimate and receive recommendations.

f. Complete plan (work out details, formulate orders).
   (1) Present tentative plan to supported unit commander or his staff.
   (2) Prepare final plan based on desires of supported unit commander and his final order.

g. Issue section order (normally an oral order).

h. Join supported units.

i. Rehearse (if time and terrain permit).

APPENDIX III

AERIAL NAVIGATION STRIP MAPS

1. GENERAL. Aerial navigation strip maps can be used as map substitutes and as a systematic method for planning and study of flight routes. A sample strip map is shown in Figure 17.

2. ELEMENTS OF AERIAL NAVIGATION STRIP MAPS. All aerial navigation strip maps should contain the following eight elements:

a. Checkpoint Number. The numbering or lettering in sequence of checkpoints.

b. Identification of Checkpoint. A simple word description of the checkpoint.

c. Sketch. A simple sketch of what the checkpoint will look like as the aircraft flies over it.

d. Distance. The distance between checkpoints in nautical miles measured on a map to the nearest half mile.

e. Magnetic Heading. The magnetic heading in degrees from one checkpoint to the next.

f. Flight Speed. The speed in knots that the aircraft is to fly from one checkpoint to the next. This is usually the cruising speed of the aircraft.

g. Altitude (Indicated). The altitude as indicated on the aircraft's altimeter. Indicated altitude includes ground elevation.

h. Time. The time rounded off to the nearest minute between checkpoints. The time is computed by using the formula in paragraph 4 below.

3. PREPARATION. In preparing aerial navigation strip maps, consideration must be given to the following factors:

a. Checkpoints must be easily recognizable from the air.

b. Time between checkpoints should be relatively uniform. As the aircraft gets closer to the landing/drop zone the checkpoints should be closer together to insure accuracy of navigation.

4. FORMULAS. The formulas used in computing time and distance are as follows:

a. Time: $T = \frac{Dx60}{R}$

T = Time
D = Distance
60 = Constant
R = Rate (speed) of aircraft in knots.

EXAMPLE: Distance: 10 nautical miles

Rate: 90 knots

$\frac{10x60}{90} = \frac{600}{90} = 6.6 = 7$ minutes

NOTE: ROUND TIME OFF TO NEAREST WHOLE MINUTE.

b. Distance: $D = \frac{RxT}{60}$

Rate: 90 knots
Time: 10 minutes

$\frac{90x10}{60} = \frac{900}{60} = 15$ nautical miles

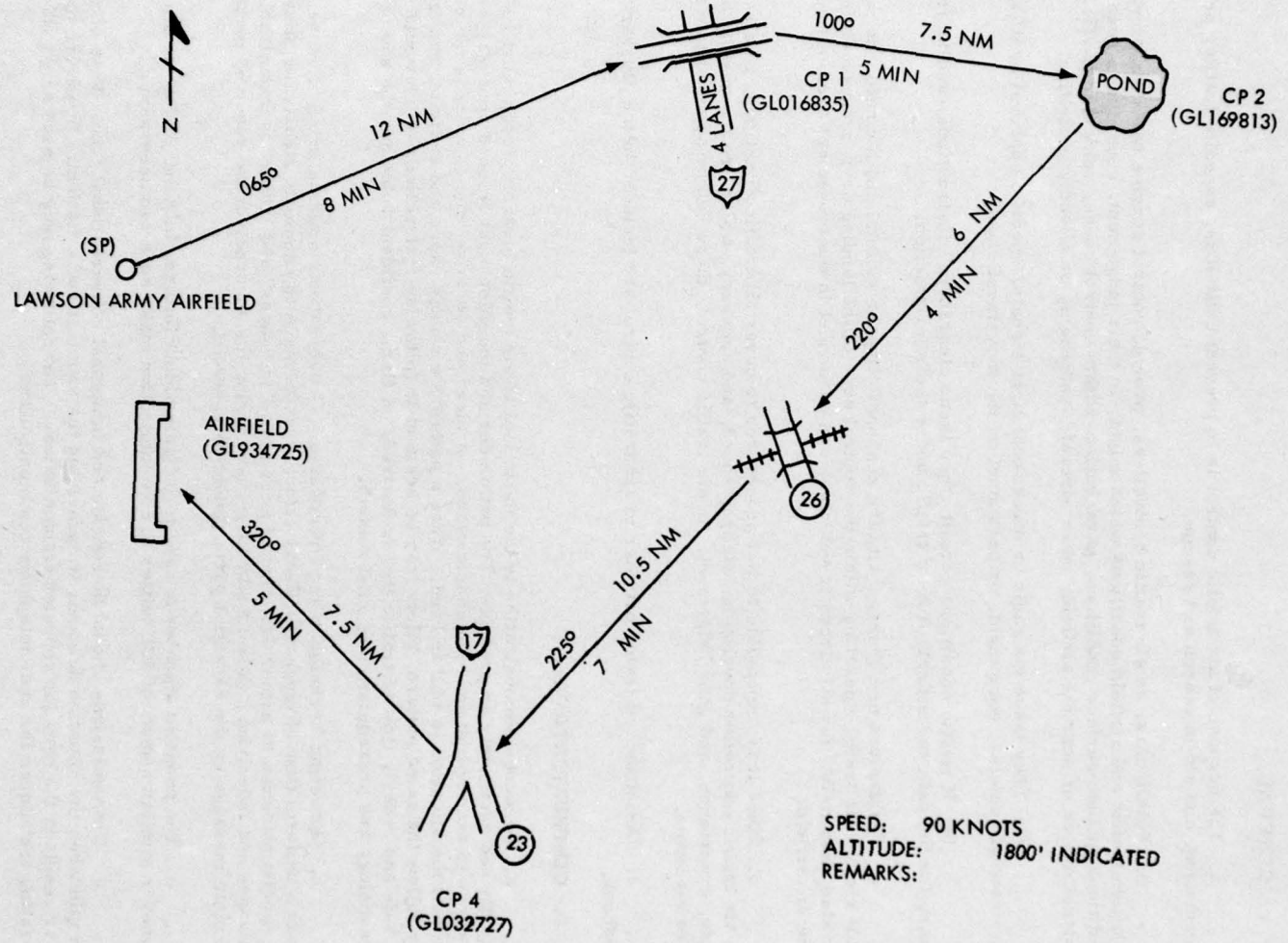


Figure 17. Sample Aerial Navigation Stip Map.

APPENDIX IV

AIR TRAFFIC CONTROL

1. GENERAL.

a. The purpose of air traffic control is to prevent collisions, expedite traffic, provide flight information, and aid in search and rescue.

b. Pathfinders, as air traffic controllers, provide control service based only upon observed or known traffic and airfield conditions which might, in their judgement, constitute a hazard. These conditions include surface conditions, parachutists within control zones, vehicular traffic, temporary obstructions on or near the airfield, other aircraft, and enemy or friendly activities.

(1) They issue via radio or directional light signals, specific approval or disapproval for movement of vehicles, equipment, or personnel on the movement area.

(2) If traffic conditions permit, they issue clearances, instructions, and information necessary for the safe and orderly flow of traffic under their jurisdiction.

c. Pathfinders are charged with the responsibility for maintaining a continuous surveillance of all visible air traffic operating within the control zone of the landing drop zone or airfield. They are also responsible for all aircraft, vehicles, and personnel in the movement area of the landing/drop zone or airfield.

d. Since it is impossible to list procedures to cover all traffic situations, it is essential that the air traffic controller develop knowledge, speed, and accuracy, which are the results of application, study, experience, and good judgement. In air traffic control, there can be no substitute for these three elements.

e. Definitions of terms peculiar to air traffic control are included in the glossary of this handbook.

2. COMMUNICATIONS.

a. Because communication is the basic tool of air traffic control, words must be used as efficiently and accurately as possible. The pathfinder and the pilot must be good speakers as well as listeners to accomplish good communications. A clear and decisive tone of voice is the best indication that the situation is well in hand. When a pathfinder sounds vague and hesitant, the traffic flow may follow the same pattern, pilots may be hesitant in following instructions which would not facilitate the safe and orderly flow of traffic that is desired. A firm, confident voice and the use of standard phraseology are prerequisites of good control.

b. Operating Techniques and Procedures. Conversations must be brief, concise, unhesitating, and in a uniform flow of language. Every effort must be made to enunicate clearly and distinctly, paying special attention to numerals. Use of such words as "guess" and "think" is undesirable since they are vague and indecisive. When doubt exists concerning the accuracy of the received message, the complete message or the essential parts should be repeated.

c. The phonetic alphabet is used to indicate single letters, initials, or for spelling words whenever similar sounds of difficulties in communication make such use necessary.

d. Transmissions should be concise and in normal conversational tone. Rate of speech may be rapid when the situation demands it, providing the enunication is distinct. However, the speed must never result in the need for repeated transmissions. The following may be used as a guide to good operating techniques for radiotelephone communications:

(1) Speak directly into the microphone.

(2) Speak in normal conversational tone.

(3) Avoid monotonous pitch.

(4) Avoid a too slow or too fast rate of speech.

(5) Avoid any display of emotion, nervousness, indecision, or excitement.

(6) Above all, speak with confidence, especially during emergency situations, to instill confidence in others.

e. Transmit only those messages necessary for air traffic control or otherwise contributing to air safety. Specified procedures and control techniques vary, but the following basic rules apply regardless of the techniques that are used.

(1) The pathfinder is responsible for issuing instructions and information relative to all known traffic conditions.

(2) All turns by the pilot around the landing strip will be left-hand, unless otherwise specified by the pathfinder.

(3) At least one component of a standard traffic pattern (final approach) will be used by the pilot, consistent with instructions issued by the pathfinder.

(4) Pilots have the final authority for the acceptance of clearances issued by a controller.

f. Initiate radio communication with an aircraft by using the following format:

(1) Initial call-up of an aircraft by ground control:

(a) Identification of the aircraft being called.

(b) The words "this is."

(c) Identification of the calling unit.

(d) The type of message to follow, when this will assist the pilot.

(e) The word "OVER."

EXAMPLE: "Fresno Tiles 112, this is Alfa Control; Over."

(2) Replying to initial call-up from aircraft:

(a) Identification of aircraft initiating the call-up.

(b) The words "this is."

(c) Identification of the replying unit.

(d) The word "OVER."

EXAMPLE: "Fresno Tiles 112, this is Alfa Control; Over."

(3) Always preface a clearance of instruction intended for a specific aircraft with the identification of that aircraft.

EXAMPLE: "Fresno Tile 112, clear to taxi."

(4) Shorten transmissions as follows when no confusion is likely:

(a) Use only the last three digits or letters of aircraft identification after communications have been established and the type of aircraft is known.

EXAMPLE: "112, clear to land."

(b) Omit the words "this is" from call-up or reply.

EXAMPLE: "112, Alfa Control; Over."

(c) Omit the facility identification after communications have been established.

EXAMPLE: "112, turn to heading 045; Over."

(d) Transmit a message immediately after call-up (without waiting for aircraft reply) when it is short and receipt is generally assured.

EXAMPLE: "112, extend downwind."

(e) Omit the word "OVER" if the message abviously requires a reply.

EXAMPLE: "112, what's your location?"

(5) Emphasize appropriate digits, letters, or words to distinguish between similar aircraft identifications.

g. During the final approach, touchdown, landing roll, take-off and initial climb, and turnaway from the field, it is of the utmost importance that the pilot give his undivided attention to flying the aircraft. For this reason, the controller should refrain from transmitting to him during these phases of operation. However, any observed condition or known information which may affect safety of flight is transmitted at any time. Under no circumstance is information pertaining to hazardous runway, field, weather, or traffic conditions withheld from the pilot of an approaching aircraft.

3. USE OF NUMBERS IN AIR TRAFFIC CONTROL OPERATIONS.

a. Figures indicating hundreds and thousands in round numbers, as for ceiling heights and flight altitudes will be spoken in accordance with the following examples:

EXAMPLES:		
	500	-Five hundred (Or five zero zero, for addditional emphasis)
	1,300	-One thousand three hundred
	11,495	-One one four niner five

b. Time: State the word "time," followed by the digits specified:

EXAMPLES:	TIME (12 HR)	TIME (24 HR)	STATEMENT
	1:15 A.M.	0115	Time, zero one one five
	1:15 P.M.	1315	Time, one three one five

c. Field Elevations: Field elevations will be stated in feet in accordance with the following:

EXAMPLES:	ELEVATION	STATEMENT
	17 feet	Field elevation One Seven
	583 feet	Field elevation Five Eight Three

d. The number "0" except where it appears in group form: State the word "Zero."

e. Surface Wind: State the word "Wind," followed by the indicated wind direction, the words "degrees at," and the indicated velocity in knots.

EXAMPLE: "Wind 270 degrees at 5."

f. Heading: State the word "heading," followed by the three digits of the number of degrees and omit the word "degrees." Use "heading 360" to indicate a north heading.

EXAMPLES: "Heading 120"
"Heading 005"

4. PHRASEOLOGY. Phraseology is a manner of expressing air traffic control terminology. Familiarity with the following phrases is essential in order to adequately talk to and control aircraft:

a. To issue take-off clearance when a delay is not desired:

EXAMPLE: "Cleared for immeduate take-off."

b. To issue take-off clearance when aircraft is delaying on the runway:

EXAMPLE: "Take-off immediately or taxi off the runway."

c. Pilot requesting straight-in approach (after landing instructions have been issued):

EXAMPLE: "Alfa Control this is Muddy 750, request straight-in approach to runway 18."

d. Pathfinder authorizing straight-in approach.

EXAMPLE: "Muddy 750, straight-in approach to runway 18 approved."

e. Pathfinder authorizing right-hand traffic pattern:

EXAMPLE: "Muddy 750, right traffic approved."

f. Pathfinder issuing a landing sequence:

EXAMPLE: "Muddy 750, you're number three to land, follow CV-2 385 on downwind."

g. Pathfinder instructing an aircraft to extend downwind leg in order to obtain necessary aircraft separation:

EXAMPLE: "Muddy 750, extend downwind."

h. Pathfinder advising an aircraft of pertinent information not included in landing instructions:

EXAMPLE: "Muddy 750, be advised we are receiving automatic fire from the east."

i. Pathfinder trying to ascertain the identification of an aircraft in his area:

EXAMPLE: "UH-1 one mile west of Dekkar Strip, say ID."

j. Pathfinder instructing an aircraft to circle the field:

EXAMPLE: "Muddy 750, circle the field."

k. Pathfinder issuing clearance to land:

EXAMPLE: "Muddy 750, clear to land."

l. Pathfinder instructing an aircraft on final landing that clearance has been cancelled:

EXAMPLE: "Muddy 750, go around."

m. Pathfinder informing an aircraft that it should continue its approach to the landing area:

EXAMPLE: "Muddy 750, continue approach."

n. To inform an aircraft of an observed aircraft condition when requested or when you deem necessary:

EXAMPLE: "Muddy 750, landing gear appears down and in place."

o. To describe vehicles, equipment, or personnel on the movement area in a manner which will assist pilots in recognizing them:

EXAMPLE: "Muddy 750, aircraft to left of runway."
"Myddy 750, vehicles on taxi-way."

p. Describe military traffic by either of the following as appropriate:

(1) Service and type:

EXAMPLE: "Army helicopter on departure end."

(2) To pilots familiar with military designations as a group figure rather than individual fires:

EXAMPLE: "Muddy 750, be advised CH-47 on right side of runway."

q. Describe the relative positions of traffic in an easy-to-understand manner, such as "to your right" or "ahead of you," instead of local terminology or compass directions:

EXAMPLE: "Muddy 750, CV-2 on downwind to your left."

5. AIR TRAFFIC COMMUNICATION WORDS.

ABORT--A failure to complete a landing or take-off for any reason.

ACKNOWLEDGE--Let me know that you have received and understand the message.

AFFIRMATIVE--Yes.

APPROVED--When a pilot's request for a certain clearance can be met.

BE ADVISED--I am informing you of an unusual condition or hazard to flight.

BREAK--(1) To indicate the separation between back-to-back transmissions to two separate aircraft.
(2) To indicate the separation of the text from other portions of the message.

CORRECTION--An error has been made in this transmission; the correct version is .....

DO NOT LAND--Self-explanatory.

EXECUTE--Commence dropping personnel or equipment.

GO AHEAD--Proceed with your message. Normally used when answering a call-up.

GO AROUND--Do not land; terminate your approach for landing; circle the landing area and begin another approach.

HOW DO YOU HEAR ME? --Self-explanatory.

I SAY AGAIN--Self-explanatory.

MAYDAY--An emergency is in effect, clear the airways.

NEGATIVE--That is not correct.

NO DROP--Cease dropping or do not drop personnel or equipment.

OUT--This transmission is ended and no response is expected.

OVER--My transmission is ended and I expect response from you.

READ BACK--Repeat all this message back to me.

REPORT--Instruction to an aircraft to contact the control facility when reaching a designated location, i.e., "report one mile final."

ROGER--I have received and understand all of your last transmission.

SAY AGAIN--Self-explanatory.

SAY I. D. --Identify yourself.

SPEAK LOUDER--Self-explanatory.

STAND-BY--(1) Must pause for a few seconds. (2) Prepare to drop personnel or equipment.

THAT IS CORRECT--Self-explanatory.

UNABLE TO APPROVE--When a pilot's request for a certain clearance cannot be met.

UNKNOWN STATION--The identity of the station with whom I am attempting to establish communication is unknown.

USE CAUTION--Self-explanatory.

VERIFY--Check with the originator.

WORDS TWICE--Communication is difficult, transmit each phrase twice. This proword may be used as an order, request, or as information.

WHAT ARE YOUR INTENTIONS? --Self-explanatory.

WILCO--Will comply.

YOU ARE UNREADABLE (BROKEN, GARBLED)--Your radio transmission cannot be understood.

6. TRAFFIC PATTERN.

a. A traffic pattern (Fig 18) is used to maintain control in an around a landing site, airfield, or drop zone.

b. Left-hand traffic pattern. The aircraft makes all left turns, keeping airfield, landing site, or drop zone to the pilot's left. This is the normal traffic pattern.

c. Right-hand traffic pattern. The aircraft makes all right turns, keeping airfield, landing site, or drop zone to the pilot's right.

d. An aircraft may enter the traffic pattern from any point and from any direction within the area surrounding the landing strip/site, consistent with safety requirements.

e. A straight-in approach is on a line within 20 degrees of the center line of the landing strip.

f. A traffic pattern normally extends out to one (1) miles from the center line of the landing area in all directions, depending on the type of aircraft or size of the facility.

g. The altitude flown while in the traffic pattern is normally between 1000 and 1200 feet.

h. There are five (5) legs to a traffic pattern:

(1) Upwind leg. A flight course parallel to the landing runway in the direction of landing.

(2) Crosswind leg. A flight course at right angles to the landing runway off its upwind leg.

(3) Downwind leg. A flight course parallel to the landing runway in the direction opposite to landing.

(4) Base leg. A flight course at right angles to the landing runway off its approach and extending from the downwind leg to the intersection of the runway center line extended.

(5) Final approach. A flight course in the direction of landing along the runway center line, extending from the base leg down to the runway.

7. FIELD CONDITION INFORMATION. As a pathfinder air traffic controller, you must issue pertinent field condition information necessary for an aircraft's safe operation in time for it to be useful to the pilot. Include the following information, as appropriate:

a. Construction work on or immediately adjacent to the movement area.

b. Rough portions of the movement area.

c. Braking conditions caused by ice, snow, mud, slush, or water on the runway.

d. Parked aircraft on the movement area.

e. Any other pertinent field operations, situations, or conditions.

8. ADVISORY SERVICE. Locations and configurations of airfields and landing sites vary greatly. It is safe to say that no two areas and situations encountered will be identical. A different location presents problems of its own with respect to environmental conditions, peculiar weather characteristics, a preferential landing direction, and other considerations. The following are some typical examples:

a. The final approach to a particular runway may require a glide slope angle that is higher than normal.

b. Unusual terrain features near the airfield may, under certain wind conditions, create turbulence that can be hazardous to aircraft operating nearby. Additionally, helicopters operating on or adjacent to the airfield can create turbulence which may be hazardous to light aircraft.

c. Turns immediately after take-off from some runways may be required due to prohibited areas, mountains, or other obstacles directly in line with the end of the runway.

d. Known friendly artillery or mortar fire within the control zone will require that the pathfinder give the aviator information pertaining to the origin, range, direction, and maximum ordinate of the firing. Air strikes within the control zone, especially those involving high performance aircraft, must also be included.

e. Information pertaining to enemy situation must be given to the aircraft.

9. TAXIING AIRCRAFT.

a. When issuing taxi information, include the route for the aircraft to follow on the movement area, plus instructions to hold at a specific point, if necessary. However, movement of aircraft within loading, maintenance, dispersal, or parking areas is the responsibility of the pilot, although he might be assisted by signalmen. Issue concise and easy to understand taxi information.

EXAMPLE: "Muddy 750, turn right at signalman."

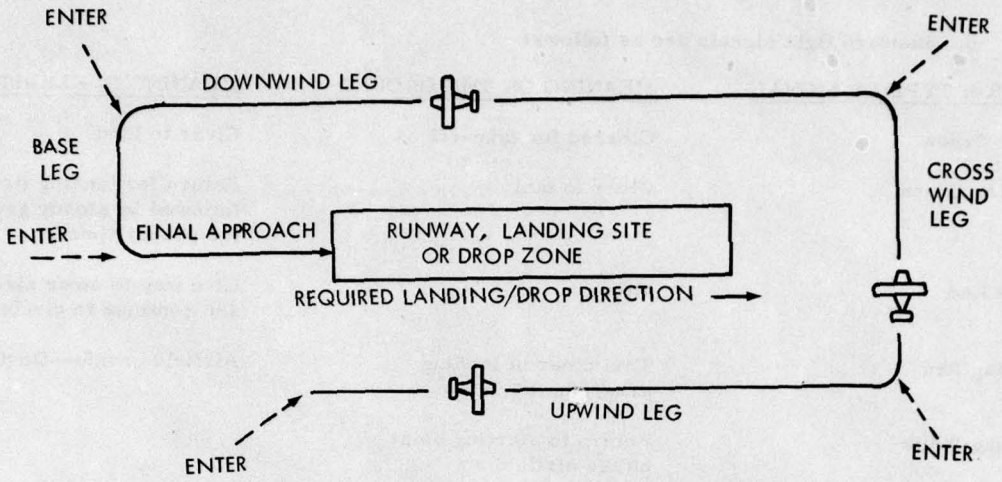
"Serpent 412, turn left at end of runway."

b. Hold a taxiing aircraft short of an active runway at least two airplane lengths, to insure that landing aircraft have sufficient clearance.

10. VISUAL SIGNAL PROCEDURES AND TECHNIQUES.

a. A rapid and efficient means of communications between aircraft and ground stations is a necessity in air traffic control. Two-way radio is the most advantageous system since information can

LEFT-HAND TRAFFIC PATTERN (STANDARD)



NOTES: a) TRAFFIC PATTERN ALTITUDE IS NORMALLY 1000-1200 FT ACTUAL
b) TRAFFIC PATTERN MAY EXTEND OUT TO ONE MILE IN ALL DIRECTIONS FROM THE RUNWAY, LANDING SITE, OR DROP ZONE.

RIGHT-HAND TRAFFIC PATTERN

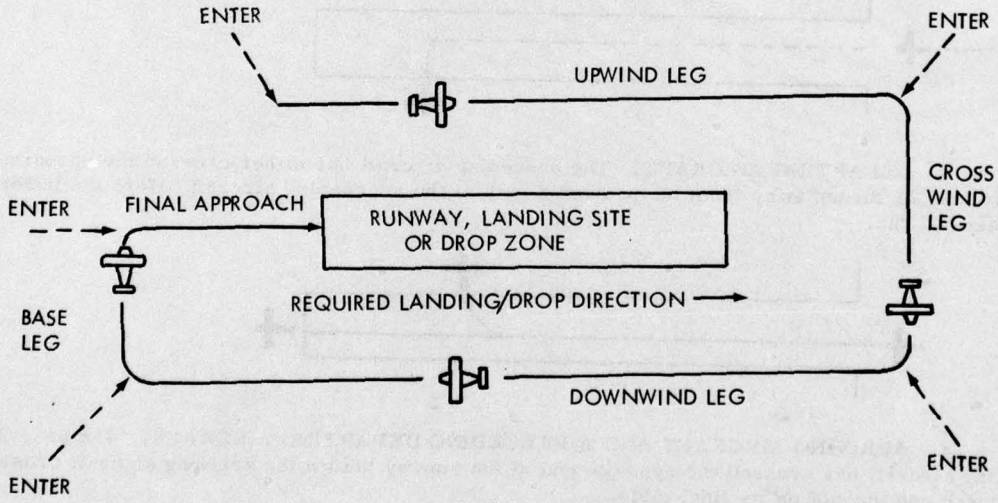


Figure 18. Air Traffic Patterns.

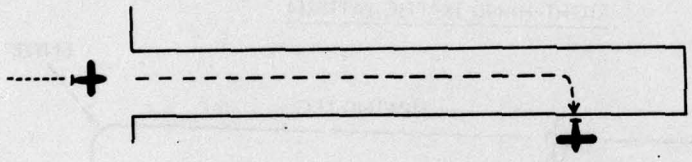
be exchanged quickly and there is little doubt as to the intent of the messages. Since all aircraft may not be equipped with operative radios, however, a system of visual signals has been established. Colored smoke signals may also be used, but prior coordination must be made between the pathfinder and the aviation unit. The visual system also serves as a stand-by or back-up means of communications in case of radio failure in the aircraft or control center, or if an aircraft desires to land and does not have the control frequency.

b. Standard light signals are as follows:

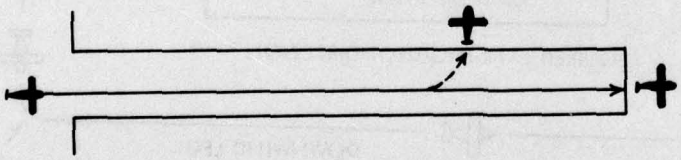
COLOR & TYPE OF SIGNAL	MEANING ON THE GROUND	MEANING IN FLIGHT
Steady Green	Cleared for take-off	Clear to land.
Flashing Green	Clear to taxi	Return for landing (to be followed by steady green at the proper time).
Steady Red	Stop	Give way to other aircraft and continue to circle.
Flashing Red	Taxi clear of landing area/runway in use	Airfield unsafe--Do not land.
Flashing White	Return to starting point on the airfield	
Alternating Red and Green	GENERAL WARNING SYSTEM--EXERCISE EXTREME CAUTION.	

11. MINIMUM SEPARATION REQUIREMENTS. The following minimum separation criteria should be followed during normal operations. Combat situations, however, may often dictate less separation:

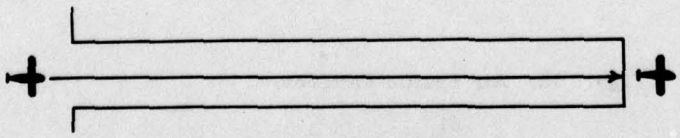
a. ARRIVING AIRCRAFT. The preceding aircraft has taxied off the landing strip before the succeeding aircraft crosses the approach end thereof on its final glide:



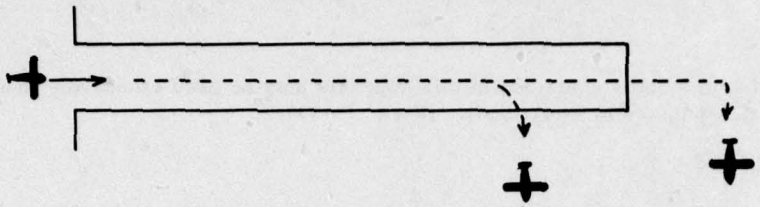
b. DEPARTING AIRCRAFT. The preceding aircraft has either crossed the opposite end of the runway or turned away from the projected path of the succeeding aircraft before the latter begins its take-off run.



c. ARRIVING AIRCRAFT AND A PRECEDING DEPARTING AIRCRAFT. The preceding departing aircraft has crossed the opposite end of the runway before the arriving aircraft crosses the approach end thereof on its final glide.



d. DEPARTING AIRCRAFT AND A PRECEDING ARRIVING AIRCRAFT. The preceding arriving aircraft has taxied off the runway before the departing aircraft begins take-off run.



APPENDIX V

STANDARD HAND AND ARM SIGNALS

1. GENERAL.

The standard hand and arm signals contained in this appendix may be used effectively to assist in landing, hovering or taxiing, and parking of aircraft. (Figs. 19-33)

2. CONDUCT OF SIGNALLING.

a. Signal must be given in a clear, distinct manner so as not to be confused with other similar signals. Signals should be given only when needed.

b. Signals at night are given using lighted batons or flashlights in each hand. Signals given at night are identical to the day signals. When using flashlights, care must be taken to preclude blinding the pilot. Batons and flashlights should remain lighted at ALL TIMES when signalling.

c. Speed of arm movement indicates desired speed of aircraft compliance with signal.

Fig 19 The position for the signalman when directing a helicopter is to the right front of the aircraft, where he can best be seen by the pilot. When directing armed helicopters, the signalman should not position himself directly in front of the aircraft at any time.

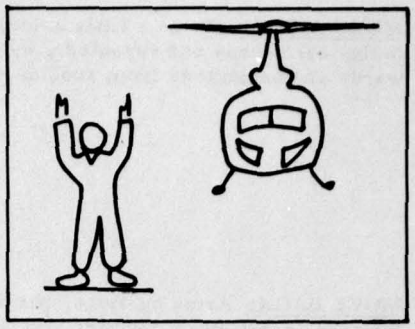


Fig 20 ASSUME GUIDANCE: Arms above the head in vertical position with palms facing inward.

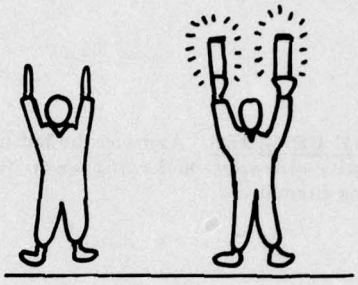


Fig 21 PROCEED TO NEXT SIGNALMAN: Right or left arm down, other arm moved across the body and extended to indicate direction to next signalman.

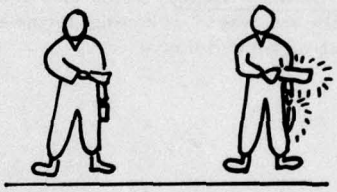


Fig 22 HOVER: Arms extended horizontally sideways, palms downward.

NOTE: When guiding a landing helicopter, this signal normally should not be given until the helicopter is approximately five feet off the ground and just short of the desired landing point, depending on its forward speed.

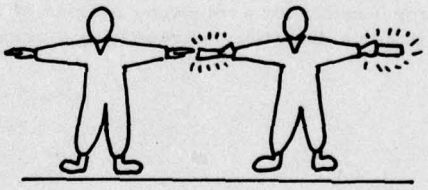


Fig 23 MOVE AHEAD: Arms a little aside, palms facing backwards and repeatedly moved upwards and backwards from shoulder height.



Fig 24 MOVE BACK: Arms by sides, palms facing forward, arms swept forward and upward repeatedly to shoulder height.

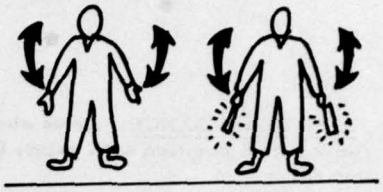


Fig 25 MOVE UPWARDS: Arms extended horizontally sideways beckoning upwards, with palms turned up.

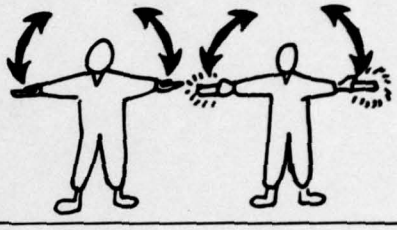


Fig 26 MOVE DOWNWARDS: Arms extended horizontally sideways beckoning downwards, with palms turned down.

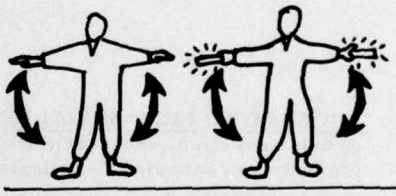


Fig 27 MOVE LEFT: Right arm extended horizontally sideways in direction of movement and other arm swung in front of body in same direction, in repeating movement.



Fig 28 MOVE RIGHT: Left arm extended horizontally sideways in direction of movement and other arm swung in front of body in same direction, in repeating movement.



Fig 29 SPOT TURN: Left or right hand moving upward and backward, from a horizontal position, to indicate direction of tail movement. Other hand pointing to center of spot turn. Signalman must remain in full view of the pilot.

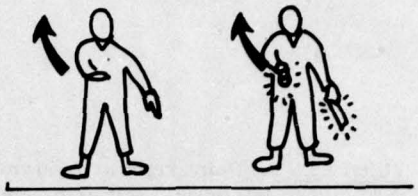


Fig 30 LAND: Arms crossed and extended downward in front of the body.

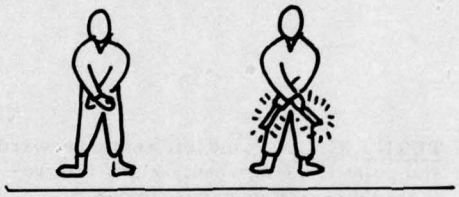


Fig 31 STOP: Arms repeatedly crossed above the head. (May be used to indicate "go around.")

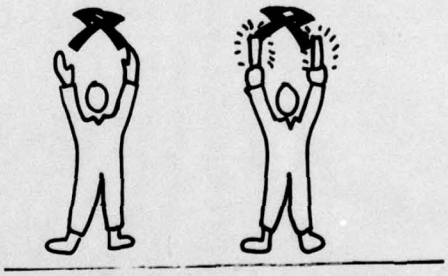


Fig 32 TAKE-OFF: Make circular motion with right hand overhead, ending in a throwing motion in the direction of take-off.

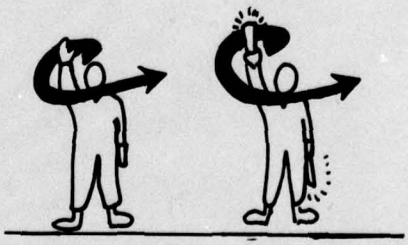


Fig 33 The position for the signalman when directing airplanes is forward of the left wingtip in full view of the pilot.

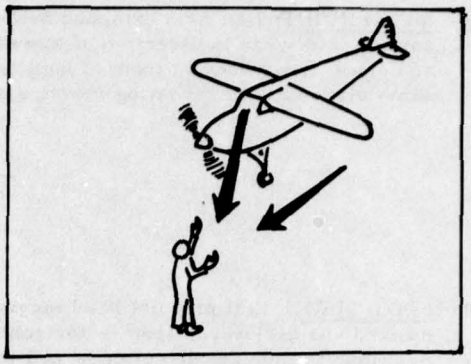


Fig 34 TURN LEFT: Point right arm downward and point to left wheel, left arm repeatedly moved upward-backward.

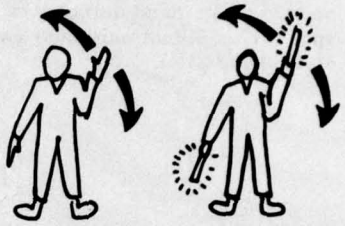
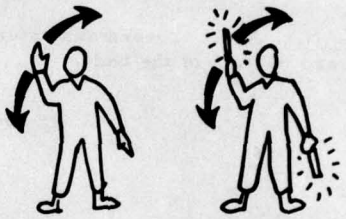


Fig 35 TURN RIGHT: Point left arm downward and point to right wheel, right arm repeatedly moved upward-backward.



APPENDIX VI

GLOSSARY

ADVISORY SERVICE - Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movement.

AERIAL FIRE SUPPORT - A capability of Army aviation to provide the ground force commander with offensive and defensive fires for the destruction or neutralization of enemy targets.

AERIAL FIRE REQUEST - A request for any aerial fire support means to provide offensive or defensive fires for the destruction or neutralization of enemy targets.

AERIAL ROCKET ARTILLERY - Army helicopters configured with an air-to-ground rocket delivery system, used for area fire, and organic to an artillery battalion.

AERIAL SURVEILLANCE - The observation of specific air or surface areas by visual electronic, photographic, or other means to provide timely intelligence information for supported tactical ground commanders.

AERIAL CONTROL POINT (ACP) - An easily identifiable topographic feature of the terrain or an electronic navigational aid along a flight route to control an air borne formation to and from the objective area.

AIR TRAFFIC - Aircraft operation in the air or on an airport surface, exclusive of loading ramps and parking areas.

AIR TRAFFIC CONTROL (ATC) - Air traffic control is an agency that provides services to promote the safe and expeditious flow of air traffic.

AIRMOBILE COMBAT ASSAULT (CA) - (Combat assault helicopter assault force) Tactical organization combining helicopter and supported ground units, to conduct combat operations into an unsecure LZ.

AIRMOBILE FORCE (AMF) - (airmobile units) The aviation and ground combat elements combined to conduct airmobile operations.

AIRMOBILE OPERATIONS - Operations in which forces and their equipment move about the battlefield in air vehicles, under the control of the ground force commander to engage in ground combat.

AIR MOVEMENT PLAN - Used in detailed planning for an airlift, when the airlift of troops is involved. It is prepared jointly by the respective ground force and aviation unit commanders.

AIRPORT - An area of land or water that is used or intended to be used for the landing and takeoff of aircraft, and includes its buildings and facilities, if any.

AIRPORT TRAFFIC AREA - Unless otherwise specifically designated, that air space within a horizontal radius of five statute miles from the geographical center of any airport at which a control facility is operating, extending from the surface up to, but not including, 2,000 feet above the surface.

ALLOWABLE CARGO LOAD (ACL) - The number of troops, amount of cargo, or combination determined by weight, cubic displacement, and distance to be flown, which may be transported by one aircraft in one sortie.

ALTERNATE LANDING SITE - A site selected to support a ground tactical plan and used if enemy action, unfavorable terrain or change in situation require a change from primary landing site.

ALTIMETER SETTING - A barometric pressure in inches (of mercury) for setting a pressure scale type of altimeter. For example, a barometric pressure of 29.92 inches of mercury would be stated as "altimeter two niner niner two".

ASSAULT ECHELON - The lead elements of an airmobile force scheduled for initial assault of the objective area.

ASSAULT FORCE - Those units charged with the seizure of the objective area.

BASIC PLANNING GUIDE - Report prepared by ground units, showing echelonment of personnel and equipment of the units to serve as a basis for determining the aircraft needs for an operation.

CEILING - For practical purposes, the lowest height above the surface at which the total cloudiness between that level and the surface (as seen by a ground observer) covers more than half the sky.

CENTER OF GRAVITY (CG) - The point about which an object would balance if supported at that point, or the point at which the weight of an object or group of objects may be considered concentrated.

CHALK NUMBER - A single aircraft or aircraft load within a flight element.

CLEARANCE - An authorization by an air traffic controller, for the purpose of preventing collisions between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled air space.

CLOSED TRAFFIC - Air traffic that remains within the traffic pattern around a landing site.

COMBAT LOADING (CROSS LOADING) - The loading of personnel to maintain tactical integrity consistent with type aircraft; and the storage of equipment and supplies to permit direct employment into the area of operations.

COMMAND AND CONTROL AIRCRAFT (C AND C A/C) - An aircraft, usually a UH-1D, equipped with additional FM and UHF radios and used by the airmobile force commander and his staff in controlling airmobile operations.

COMMUNICATION CHECKPOINT (CCP) - An easily identifiable topographic feature on the terrain along a flight route over which aircraft inbound to a landing/drop zone initiate radio contact with a control facility at the landing/drop zone.

CONTOUR FLYING - Low altitude flight in which the flight pattern conforms generally to the contours of the ground. It is used to avoid observation or detection of an aircraft and/or the points to and from which it is flying.

CONTROL CENTER - A location from which appointed personnel control air traffic in and around a landing drop zone to promote safe, orderly, and expeditious air movement.

CONTROL ZONE - Control zones extend upward from the surface. A control zone may include one or more landing/drop zones and is normally a circular area of five statute miles in radius with extensions where necessary to include instrument approach and departure paths.

CONTROLLED AIRSPACE - Airspace designated as continental control area, control zone, or transition area, within which some or all aircraft may be subject to air traffic control.

COURSE - The intended direction of horizontal flight.

DENSITY ALTITUDE (DA) - Density altitude is determined by altitude, temperature and humidity. Generally speaking, high, hot, and dry conditions (high density altitude) will decrease the lift capability of an aircraft.

DROP ALTITUDE - Actual altitude in feet of an aircraft above the ground at the time of the initiation of an airdrop.

DROP ZONE (DZ) - A specified area upon which airborne troops, equipment and supplies are dropped by parachute, or on which supplies and equipment may be delivered by free fall.

EAGLE FLIGHT - An airmobile force either on ground or air alert to perform rapid reaction mission.

EXTRACTION - Voluntary or involuntary withdrawal by air of troops, equipment, or supplies from an area.

FINAL APPROACH (VFR) - A flight path of a landing aircraft in the direction or landing along the extended runway centerline from the base leg to the runway.

FLIGHT - Two or more Army aircraft, with a common mission, under the control of a single flight leader.

FLIGHT LEADER - An aviator who commands a designated flight of aircraft on a common mission supporting one unit.

FM HOME - A directional homing or beacon signal given by keying an FM radio.

GLIDE SLOPE - The vertical slope between an aircraft and the landing surface during an approach. The glide slope is normally expressed in degrees.

GLIDE SLOPE INDICATOR (GSI) - A device designed to emit a visual, three-color light beam which indicates to an aviator a safe glide path for an aircraft over approach obstacles into a landing site.

GROUND CONTROLLED APPROACH (GCA) - Landing, usually under IFR conditions, accomplished with the assistance of a ground controller using radio and radar to direct an aircraft to, and maintain it on, the correct course and glide path to accomplish a successful landing.

GROUND-TO-AIR RADIO - A radio used to maintain communication with aircraft.

HELIPORT - An area prepared for the accommodation, landing and take-off of helicopters only.

H-HOUR - Pertaining to airmobile/airborne operations, H-Hour is the time of touchdown of the lead ship of an assault echelon in the landing zone, or the initiation of the drop of the first load of parachutists.

HOMING BEACON - A device transmitting an electronic signal used to assist in the guidance of aircraft.

IFR CONDITIONS - Weather conditions below the minimums prescribed for flights under visual flight rules.

INTERNAL NET RADIO - A radio used to maintain communication with other elements of a pathfinder unit at the same or adjacent locations.

INSTRUMENT FLIGHT RULES (IFR) - Rules prescribed by the Civil Air Regulations governing instrument flight.

KNOTS - A unit of speed equivalent to 1 nautical mile or 6,080.2 feet per hour. Sixty nautical miles equals 1^{o} of a terrestrial great circle.

LANDING AIDS - Any system or device for aiding aircraft in an approach for landing.

LANDING FORMATION - The formation in which aircraft will land. It is desirable to land aircraft in the same formation in which they are flying.

LANDING POINT - A designated or selected touchdown point where a single aircraft lands.

LANDING SITE - A subdivision of a landing zone that contains one or more landing points.

LANDING STRIP - An airfield which may include a runway, taxiways, parking points, and dispersal areas. The three classifications of airfields are pioneer, hasty, and deliberate, depending upon the degree of improvement.

LANDING ZONE - A landing area that encompasses one or more landing sites/strips, and normally having the required control facilities.

LIFT - A tactical grouping of one or more serials of aircraft operating on an assigned mission.

LIGHT GUN - A long range, highly directional, visual signalling device normally used in a ground-to-air role.

LOCAL TRAFFIC - Aircraft operating in the traffic pattern of the landing area concerned.

MEDICAL EVACUATION (MEDEVAC) - The primary mission of air ambulance units and a secondary mission of all Army aircraft.

MINIMUM SAFETY ALTITUDE - The altitude below which it is hazardous to fly.

MOVEMENT AREA - The part of the airfield reserved for taking off, landing, and taxing of aircraft.

PATHFINDER (PFDR) - Trained individuals who provide navigational assistance to and control of aircraft.

PICKUP ZONE (PZ) - The designation of a tactical extraction area secured by the extracted force with diminishing security after each lift.

PRE-STRIKE - Air Force, artillery, or armed helicopter fire placed on a LZ and/or objective area prior to the arrival of the airmobile task force.

RELEASE POINT (RP) - An established traffic control point and final navigational checkpoint along a flight route for aircraft approaching the landing/drop zone.

REPORTING POINT - A geographical location in relation to which the position of an aircraft is reported.

RUNWAY END - The end of that portion of the runway usable for landing or take-off.

SEARCH AND RESCUE FACILITY - A facility responsible for maintaining and operating a search and rescue service for occupants of missing or downed aircraft.

SEPARATION - Spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off; a specified longitudinal, vertical, or lateral distance between two or more aircraft in flight provided by air traffic control to insure safety in the air.

SERIAL - A tactical grouping of two or more flights, under control of a single mission commander separated from other tactical grouping of flights.

SORTIE - One aircraft making one take-off and one landing.

STAGING AREA - A geographic locality between the base camp and the objective of an airmobile force through which the parts thereof pass for refueling, regrouping, inspection and redistribution of troops, to continue operations more efficiently. Encompasses as a rule, a forward logistical base, aviation fueling arming facilities, and the AMF reserve.

STATION TIME - That time when all personnel and/or material must be loaded and prepared for take-off.

STRAIGHT - IN APPROACH (VFR) - Entry of the traffic pattern by interception of the extended runway centerline without executing any other portion of the traffic pattern.

SUPPORTING AIRCRAFT - Supporting aircraft consist of all aircraft designated to provide combat support, combat service support, or command and control service to a land force.

SUPPRESSIVE FIRES - Fires placed upon known or suspected locations of enemy troops, weapons, or likely enemy positions which, because of their proximity to the flight path, present an immediate or potential threat to aircraft movement. Suppressive fires are employed during helicopter assault of an enemy position in order to greatly reduce effective enemy small arms and automatic weapon fires directed against the assault landings. Fires are provided by Army aircraft armed for the expressed mission of aerial fire support.

TAKE-OFF CLEARANCE - Authorization by an air traffic control tower for an aircraft to take-off.

TERMINAL GUIDANCE PERSONNEL - Selected personnel other than qualified pathfinders within a ground unit who are trained to provide minimum guidance, information, and control to aircraft in the absence of TOE pathfinder elements.

TRAFFIC PATTERN - The traffic flow that is prescribed for aircraft landing at, taxiing on, and taking off from an airport. The usual components of a traffic pattern are upwind leg, crosswing leg, downwind leg, base leg and final approach. A traffic pattern may also be used around a drop zone.

UHF COMMUNICATIONS - Communications using the ultra-high radio frequencies. Frequency span is 300 megacycles to 3000 megacycles.

VECTOR - A heading issued to an aircraft to provide navigational guidance by radar.

VISUAL FLIGHT RULES (VFR) - Rules prescribed by the Civil Air Regulations governing visual flight.

VFR CONDITIONS - Weather conditions equal to or better than the minimums prescribed for flights under Visual Flight Rules.

VFR FLIGHTS - Flights governed by Visual Flight Rules.

VHF COMMUNICATIONS - Communications using the very high radio frequencies. Frequency span is 30 megacycles to 300 megacycles.

APPENDIX 7

REFERENCES

ACP-168	Allied Communications Publications Pyrotechnic Signals
AR 55-10	Military Standard Transportation and Movement Procedure
AR 95 - Series	Aviation
AR 320-5	Dictionary of United States Army Terms
AR 320-50	*Authorized Abbreviations and Brevity Codes*
AR 350-1	Army Training
AR 380-5	Safeguarding Defense Information
AR 385-10	Army Safety Program
AR 735-35	Supply Procedures for TOE Units, Organizations, and Non-TOE Activities
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AR 750-8	Command Maintenance Management Inspections
ASubjSch 1-1	Aerial Navigation
ATT 7-168	Pathfinder Detachment
DA 108-1	Index of Army Motion Pictures, Film Strips, Slides, Tapes and Phono-Recordings
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DA 310-5	Index of Graphic Training Aids and Devices
DA 310-7	Index of Tables of Organization and Equipment, Type Tables of Distribution and Tables of Allowance.
DA TOE's	"G" Series
JCS PUB 1	Dictionary of U.S. Military Terms for Joint Usage (JC)
FM 1-5	Aviation Company
FM 1-10	Army Aviation Organizational Aircraft Maintenance and Supply
FM 1-15	Divisional Aviation Battalion and Group
FM 1-60	Army Aviation Air Traffic Operations - Tactical
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FM 1-100	Army Aviation Utilization
FM 1-105	Army Aviation Techniques and Procedures
FM 1-110	Armed Helicopter Employment

FM 3-10	Chemical and Biological Weapons Employment
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FM 6-20-2	Field Artillery Techniques
FM 6-135	Adjustment of Artillery Fire by the Combat Soldier
FM 7-11	Rifle Company, Infantry, Airborne Infantry and Mechanized Infantry
FM 7-15	Rifle Platoon and Squads, Infantry, Airborne and Mechanized
FM 7-20	Infantry, Airborne and Mechanized Infantry Battalions
FM 7-24	Communications in Infantry and Airborne Divisions
FM 7-30	Infantry, Airborne and Mechanized Division Brigades
FM 17-36	Divisional Armored and Air Cavalry Units
FM 21-5	Military Training Management
FM 21-6	Techniques of Military Instruction
FM 21-11	First Aid for Soldiers
FM 21-26	Map Reading
FM 21-30	Military Symbols
FM 21-31	Topographic Symbols
FM 21-40	Small Unit Procedures in Nuclear, Biological, and Chemical Warfare
FM 21-60	Visual Signals
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FM 21-76	Survival
FM 21-77	Evasion and Escape
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FM 24-1	Tactical Communications Doctrine
FM 24-18	Field Radio Techniques
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FM 31-16	Counterguerrilla Operations
FM 31-20	Special Forces Operational Techniques
FM 31-21	Guerrilla Warfare and Special Forces Operations
FM 31-22	U.S. Army Counterinsurgency Forces
FM 31-30	Jungle Training and Operations

FM 31-72	Mountain Operations
FM 31-73	Advisor Handbook for Counterinsurgency
FM 54-2	The Division Support Command
FM 54-2-1	The Airmobile Division Support Command
FM 57-10	Army Forces in Joint Airborne Operations
FM 57-35	Airmobile Operations
FM 57-38	Pathfinder Operations
FM 57-100	The Airborne Division
FM 61-100	The Division
TM 1-225	Navigation for Army Aviation
TM 1-260	Rotary Wing Flight
TM 1-300	Meteorology for Army Aviation
TM 5-330	Planning, Site Selection, and Design of Roads, Airfields, and Heliports in the Theater of Operations
TM 5-366	Planning and Design for Rapid Airfield Construction in the Theater of Operations
TM 6-20-2	Field Artillery Techniques
TM 9-1370-200	Military Pyrotechniques
TM 10-500 Series	Air Drop of Supplies and Equipment
TM 11-665-214-10	Operators Manual, Radiacmeters IM-93/UD, IM-93A/VO, and IM-147/PD
TM 11-2557-27	Air Traffic Control Procedures Manual
TM 11-5020	Antenna Equipment RC-292
TM 11-5820-398-12	Organizational Maintenance Manual: Radio Set AN/PRC-25
TM 11-5820-498-10	Operators Manual: Radio Sets AN/VRC-53, AN/GRC-53, AN/GRC-153 w/amplifier, Power Group DA 3633/CRC
TM 11-6660-232-15	Operators Manual: Wind Measuring Sets AN/PMQ-3, 3A, 3B, 3C
TM 11-6665-213-12	Operator and Organizational Maintenance Manual Radiacmeter IM-174/PD
TM 55-101	Troop Movement Guide
TM 55-450-8	Air Transport of Supplies and Equipment External-Transport Procedures
TM 55-450-9	Air Transport of Supplies and Equipment Internal-Transport Procedures

TM 55-1520-209-10	Army Model CH-47A Helicopter
TM 55-1520-210-10	Army Model UH-1D Helicopter
TM 55-1520-211-10	Army Models UH-1A and UH-1B Helicopters
TM 57-210	Air Movement of Troops and Equipment
TM 57-220	Technical Training of Parachutists
TC 6-1	Artillery Procedures
TT 1-18-1	Aviation Group, Airmobile Division
TT 1-156-1	Assault Helicopter Battalion, Airmobile Division
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TT 6-102-1	Field Artillery Battalion, Aerial Artillery, Airmobile Division
TT 7-15-1	Infantry Company, Airmobile Division
TT 7-20-1	Infantry Battalion, Airmobile Division
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TT 8-15-1	Medical Service, Airmobile Division
TT 17-95-1	Air Cavalry Squadron, Airmobile Division
TT 54-2-1	Combat Service Support and the Support Command, Airmobile Division
TT 55-7	Air Lines of Communication (ALOC) Operations in Support of the Airmobile Division
TT 61-100-1	The Division, Airmobile Supplement
USAIS Handbooks	Army Airmobility Handbook Standing Operating Procedures Infantry Reference Data Tactical Operations Handbook Intelligence Handbook Combat Logistics Handbook Personnel Handbook Artillery Handbook Engineer Handbook U.S. Air Force Basic Data Manual Operations and Training Handbook
USAAVNS Handbooks	*Common Subjects and Reference Data for Army Aviation in the Field Army* Airmobile Division Aviation Supplement to Common Subjects and Reference Data Common Subjects Instructional Syllabus
U.S. Army Vietnam	1st Aviation Brigade Operations Manual Major Divisional and Separate Brigade Units SOP's Lessons Learned Reports from Vietnam

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