SFC BURNS

FM 57-38

DEPARTMENT OF THE ARMY FIELD MANUAL

PATHFINDER OPERATIONS

HEADQUARTERS, DEPARTMENT OF THE ARMY
OCTOBER 1968

TAGO 6031A

FIELD MANUAL
No. 57–38

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *9 October 1968*

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*This manual supersedes FM 57–38, 28 March 1966.

CHAPTER 1
INTRODUCTION

1. Purpose and Scope

a. This manual is designed to provide a ready reference on the organization, the training, and the employment of TOE pathfinder units and unit terminal guidance personnel.

b. The material contained in this manual is applicable to both nuclear and nonnuclear warfare.

c. This manual describes the procedures used by pathfinder units during various types of operations. Terminal guidance personnel may also use these procedures. The fact that ground units do not have supporting TOE pathfinder units does not affect the basic guidance procedure. The manual must be used in conjunction with FMs 1–5, 1–105, 7–11, 7–15, 7–20, 7–30, 21–60, 57–35, and 61–100.

d. The tactics, techniques, and procedures described 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 may require.

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

f. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to the Commandant, United States Army Infantry School, Fort Benning, Georgia 31905.

2. Missions

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

b. Secondary missions for pathfinder units include—

(1) Providing limited advice and physical assistance to lifted units in the planning of airmobile operations.

(2) Preparing and positioning personnel and loads for air movement.

3. Capabilities

a. Pathfinder units have the following capabilities:

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

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

(3) Preparing landing or drop zones to include establishing and operating visual and electronic navigational aids and removing minor obstacles.

(4) Furnishing ground-to-air voice radio communications to aircraft for the purpose of providing information, guidance, and air traffic control within the area of operation.

(5) Providing advisory service to aviators concerning friendly mortar and artillery fires through direct coordination with colocated fire support units.

(6) Assisting in the assembly of air delivered troops, supplies, and equipment.

(7) Providing advice and limited physical assistance in preparing and positioning troops, supplies, and equipment for air movement.

(8) Conducting limited CBR monitoring or surveying of designated areas.

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

(10) Operating, by mutual agreement with the U.S. Air Force, 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 or VHF) that are compatible with Air Force aircraft. Close coordination between aviators and pathfinders must be effected in order to insure complete understanding of the markings and radio communication procedure to be used.

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. Limitations

Because pathfinder units are limited in personnel and equipment resources, their employment must be restricted to aircraft guidance and other primary tasks. It is necessary that pathfinder 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 must be a qualified parachutist and 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, TOE 1–56, and TOE 1–256).

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

c. Depending upon its 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. Navigational 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. These aids have a greater range and provide more security 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 of them 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 or visual. Avialable 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 in order to prevent misunderstandings. Visual assembly aids include panels, smoke, and armbands for day operations and lanterns, flashlights, light beacons, and pyrotechnics for night operations.

e. Miscellaneous Equipment. Miscellaneous pathfinder equipment includes vehicles, binoculars, small starlight scopes, nonelectronic 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 become qualified by successful completion of the Pathfinder Course, Airborne Department, United States Army Infantry School, Fort Benning, Georgia. Unqualified personnel serving in TOE pathfinder units in combat zones may become qualified under the provisions of a pertinent directive published by the appropriate major command.

c. Pathfinder unit training is carried out under the guidelines provided by ATT 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 outlned in Army Subject Schedule 7–50, "Air Movement Training."

CHAPTER 2

OPERATIONS

Section I. EMPLOYMENT

8. General

a. Pathfinders are employed whenever it is necessary to provide guidance and control of Army aircraft. This employment encompasses any phase of an airmobile operation or a ground operation that requires 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 and/or drop into the area.

c. Aviation units with sufficient pathfinder resources can best support airmobile operations by attaching pathfinder elements to ground units for the duration of an operation. Attachment 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 to select, improve, mark, and control landing sites as required. Engineer elements in direct support of lifted ground units may assist pathfinders in improving landing 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 of equipment should take priority over the 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 described in this section.

11. Warning Order

Upon notification of a pending operation, the pathfinder unit commander or the senior pathfinder present must alert his personnel at the earliest practicable time. The alert is followed as soon as possible by a warning order. The warning order should include sufficient information that will permit initial preparations to be made for the operation. The order should include at least—

a. A brief statement of the enemy and the friendly situation.

b. The mission.

c. Individual uniform and equipment (if not in the *SOP*).

d. Equipment required and priority of work in preparing for the operation (if not in the *SOP*).

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

f. Place, time, and uniform for receiving the operation order.

12. Initial Preparations

a. Inspection of personnel and equipment begins upon receipt of the alert or the 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. At this time, whenever possible, the pathfinder unit commander or his representative should establish initial liaison with the supported aviation and/or ground unit.

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

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 reasons. 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 the ground unit commander to make recommendations on the exact location of drop zones or landing sites, landing formations, techniques to be employed, and the time schedule to be followed. These recommendations are likely to occur during any type of operation (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 the enemy situations, 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 the staging area.

(7) Primary and alternate flight routes.

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

(9) Primary and alternate landing and/or 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 radio 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 preparing 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 an operation, 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 the assembly of personnel, supplies, and equipment of supported units.

(4) The need for assistance in removing 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 complete command of the pathfinder commander who is responsible for the functions of the entire team.

14. Joining with the Supported Unit

Pathfinders join the supported unit at the appointed time and place if they are not already colocated with or in support of the lifted unit. Joining a supported unit normally will occur in sufficient time to allow a final coordination meeting between pathfinder and aviation and lifted ground 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 normally will occur after the initial phase of the air movement has been completed.

15. Final Preparations

a. The pathfinder commander issues his operation order as soon as practicable. The operation order may be issued as a series of fragmentary orders based upon available information and 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 the operation of proposed 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 operation briefing within the pathfinder element involved is held just prior to departure. Any final coordination required between the pathfinders and supported units should also be accomplished 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, three to six me-

is the average size of a pathfinder element at a landing site, drop zone, or when in continuous support of an infantry battalion.

b. A pathfinder section is seldom employed as a unit at a single location. In tailoring his unit for the accomplishment of a 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 allows 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, a pathfinder element that is 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 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 (TM 57–220).

(3) When parachuting into an area, pathfinders carry on their person 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 nonilluminated, nonsupported night operations when secrecy is the 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 waterways in certain situations. Movement from the 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. When sufficient time is available, overland movement to an objective may be used in conjunction with parachute or air-landed infiltration to enhance security of an operation.

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. General. Pathfinder trained personnel are capable of providing air traffic control and navigational assistance within designated landing or drop zones for airplanes and helicopters or a mixture of both. They also can perform limited physical improvement and CBR monitoring and/or survey in such areas. The degree of support which pathfinder units can provide is dictated by the availability of pathfinders, the tactical plan, the complexity of the operation, the terrain, and the state of airmobile proficiency of the supported ground unit. In any airmobile operation, however, positive aircraft control is essential.

b. Helicopter Operations.

(1) *Daylight assault.* During daylight airmobile assault operations, pathfinders should accompany the initial assault elements into a landing zone. Air traffic control and other pathfinder assistance is then provided to all subsequent lifts of troops, supplies, and equipment. If pathfinders precede assault elements, the time may vary from a minimum of 3 to 5 minutes to several hours, depending upon the situation. The tactical plan, to include prestrikes in and around the landing zone by artillery, Air Force aircraft, or armed helicopters, will dictate this time, or preclude the early entry of pathfinders altogether. Normally, pathfinders will not be inserted into a landing zone prior to the initial assault echelon in daylight operations, unless the proposed landing zone requires extensive improvement or unusual control problems are anticipated.

(2) *Night assault.*

(*a*) *Nonilluminated.* Nonilluminated night helicopter assault operations are normally conducted when secrecy is the major tactical consideration. During such operations, pathfinders should be delivered ahead of the main body in order to insure adequate time for reconnaissance and marking of the landing site. The amount of time by which pathfinders will precede the assault echelon will be dictated by the type and extent of prestrikes, if any, the size of the operation, navigational difficulties anticipated, and the requirement for improvement of the landing site. Personnel from the supported ground unit and/or engineers may accompany pathfinders to provide security and to assist in clearing obstacles. This assistance frees pathfinder personnel 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 move across country on foot, be parachuted onto or near objective areas, be air landed in total blackout, or air landed with minimum illumination. The last method is often the most accurate and desirable from a pathfinder viewpoint, since it permits a hasty visal reconnaissance of the landing site, and thereby reduces the time by which pathfinders must precede the main body.

(*b*) *Illuminated.* 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 obstacles and specific touchdown-points for individual aircraft within formations.

(3) *Withdrawal* (Extraction). 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 site within ground security, thus enhancing the expeditious and safe flow of personnel, 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.

(4) *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 preparing 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 when the weather deteriorates, the number and types of aircraft increases, and changes in the situation or plans occur (para 30 and 37).

(5) *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 equipment, personnel, and ammunition (para 31).

(6) *Support of ground operations.* Pathfinder personnel may be attached to ground units to provide around-the-clock assistance and control of aircraft during operations requiring sustained Army aviation support. Pathfinders attached to infantry battalions may be further attached to companies to provide such support, consistent with availability of personnel and equipment. Such continuous support greatly enhances overall operation efficiency and aviation safety during all types of airmobile operations. However, this type of support cannot be habitually provided by aviation units possessing only limited pathfinder resources. In such cases, pathfinders are normally employed on a short-term, priority basis wherever they can best assist in the accomplishment of overall major unit missions. In the absence of pathfinders, selected personnel within ground units must be trained and prepared to provide minimum required assistance to supporting aircraft.

(7) *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 USAF Combat Control Teams, and by joint agreement, Army pathfinders may provide control for USAF aircraft in both drop and landing zones. However, it may be necessary to provide pathfinders with communications equipment (UHF and VHF) that is compatible with these aircraft.

(8) *Mixed operations.* Situations will often exist that require provisions for and simultaneous control of mixed operations at the same location; that is, resupply parachute drops into forward helicopter landing sites. As a rule, helicopter traffic can be expected at all fixing 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 (app E). 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 frequen-

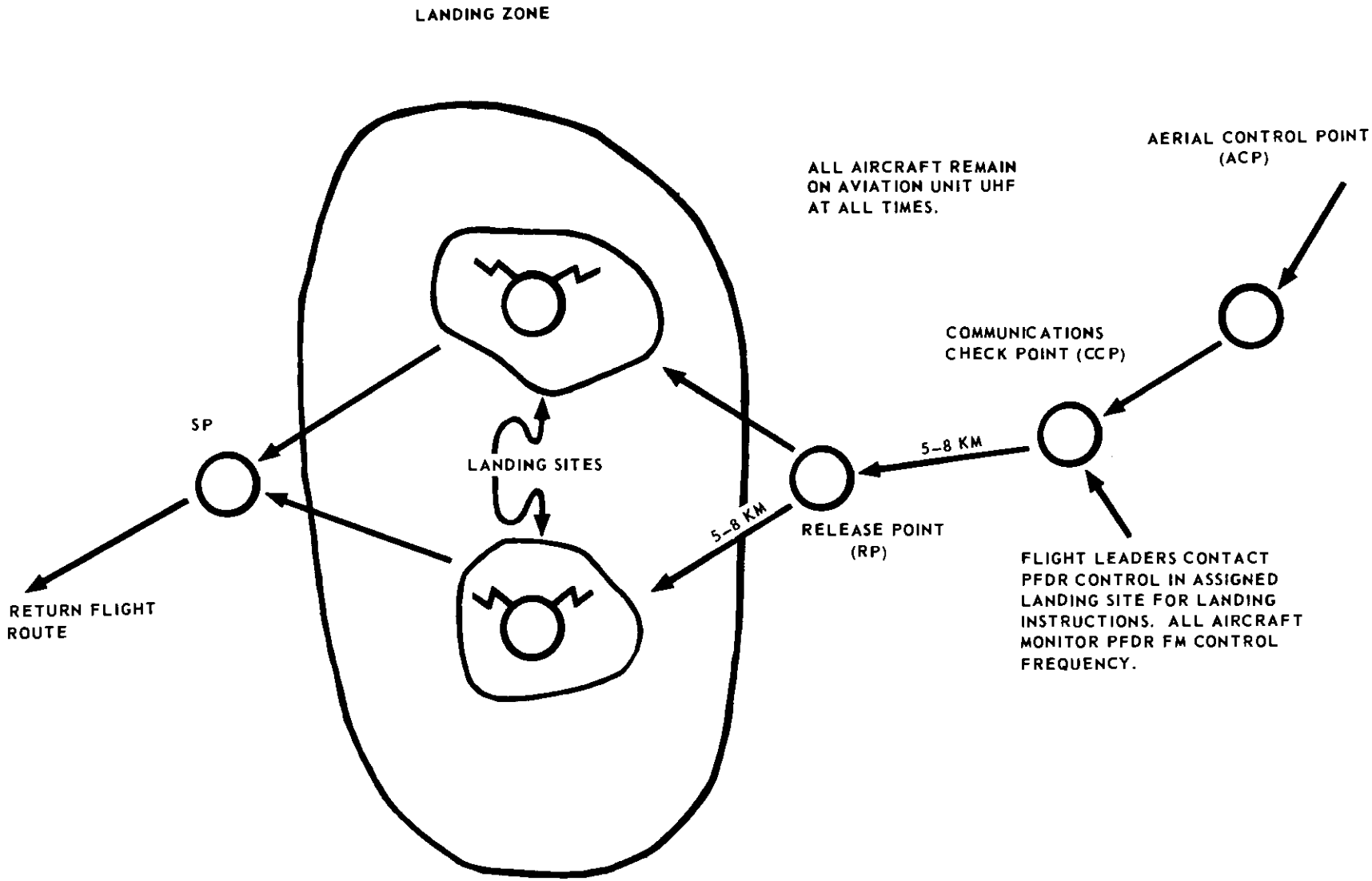


Figure 1. Enroute communications procedures with pathfinders in landing zone.

cies should be used for that purpose only, except in emergencies (fig. 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 30*b*, 37*b*, and 44*b*.

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 the aids used is found in paragraph 6. A discussion of arm-and-hand signals and visual aids is found in FM 21–60 and appendix F.

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 colocated 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 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 and 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 in order to assist aircraft in locating landing and/or 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 and/or drop sites.

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

c. When TOE pathfinders accompany ground units, terminal guidance personnel may be used to augment pathfinder elements.

CHAPTER 3

CONTROL CENTER AND RELEASE POINT

24. Landing and/or Drop Zone Control Center

a. General. The purpose of the control center (CC) (fig. 2) is to control air traffic in and around a landing and/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 pathfinder site commander selects the exact location of the control center upon arrival in the area. The CC 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 of the CC is to the side of 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, particularly necessary at night, enables the pathfinder air traffic controller to best observe the final approach of formations of helicopters, insuring correct alinement with the required landing direction and sufficient obstacle clearance by means of visual steering instructions. At an airplane landing site, the CC is located where the best observation of all air and ground traffic can be obtained. The CC 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 and/or 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 of the Control Center. 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 and/or drop zone commander.* He 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).

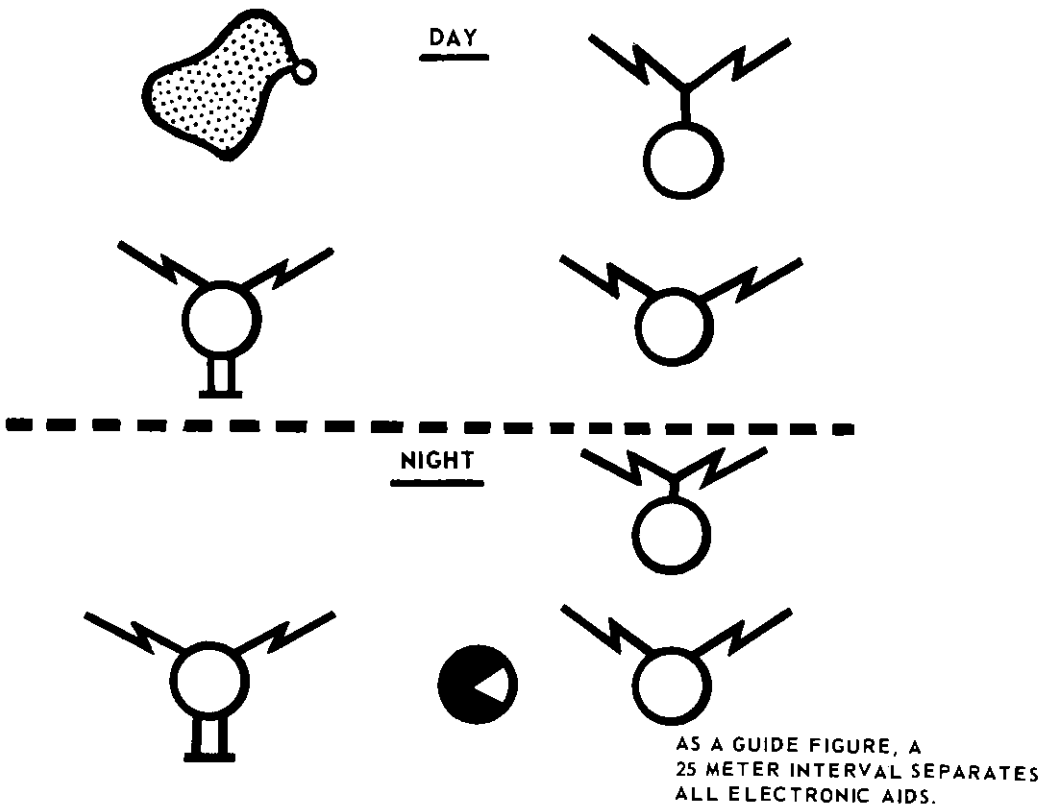
(2) *Ground-to-air radio operator.* He operates the radio used to maintain communication with aircraft, and provides the necessary voice air traffic control for his control zone.

(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 (app B) 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 and other assistance necessary.

25. Release Point

a. General. A release point (RP) (fig. 3) is an established traffic control point and final navigational checkpoint for aircraft approaching the landing or air-delivery facilities within a landing and/or drop zone. The RP is also used by helicopter serials as a final coordination point for control of preplanned ground or



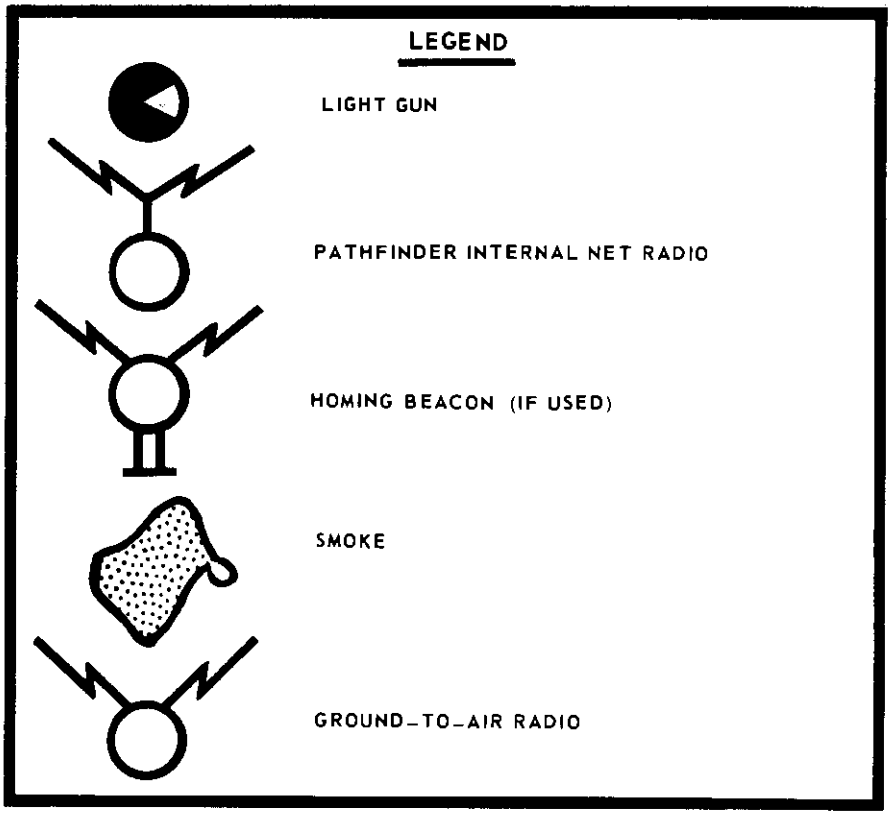


Figure 2. Control center (CC).

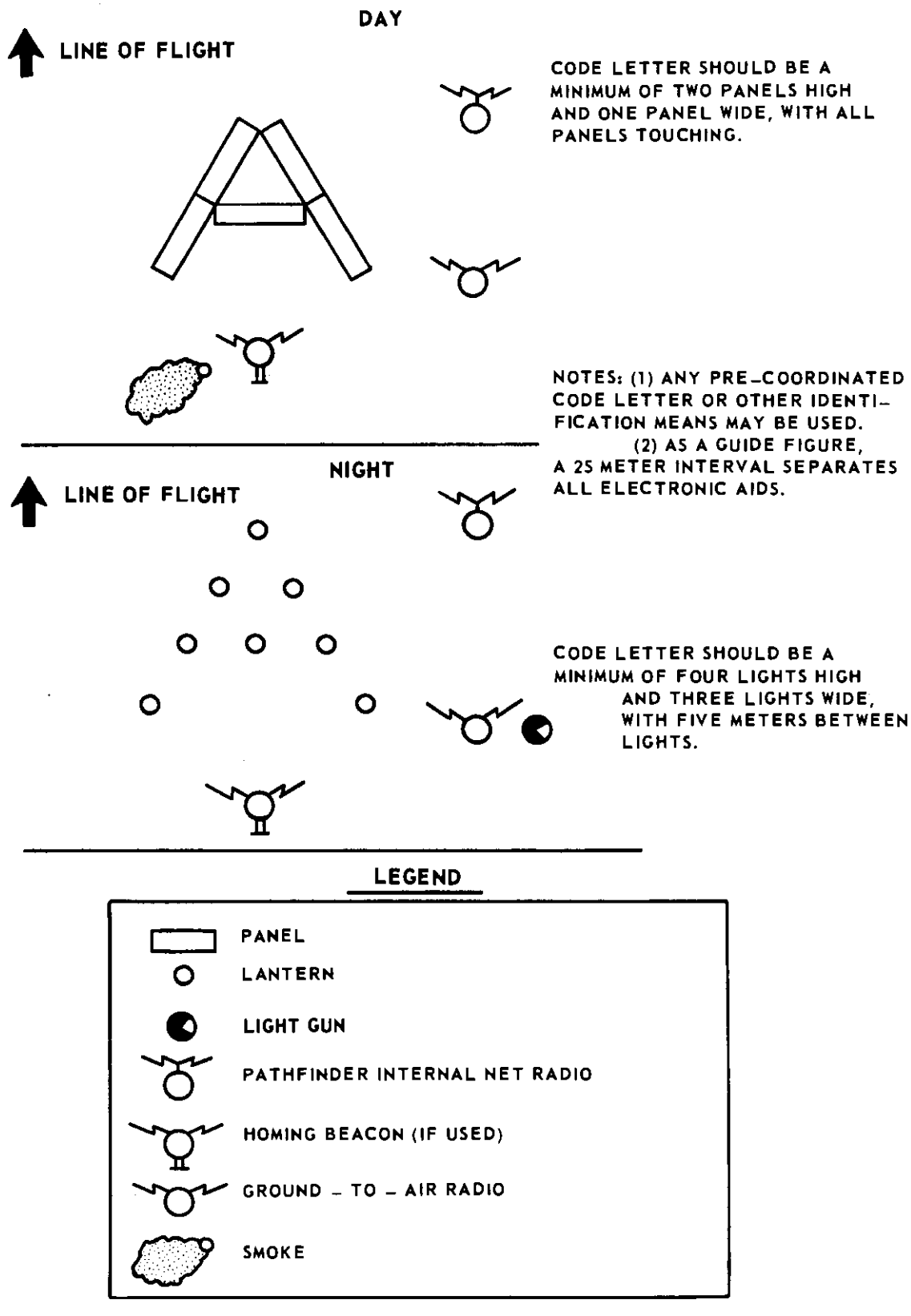


Figure 8. Release point (RP).

aerial supporting fires in and around landing sites during the air movement phase of an air-mobile 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 an easily identifiable point on the planned flight route to the landing zone. If manned, the RP 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 it 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 the 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 who are used 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. The electronic homing beacon is then installed, 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 *SOP*s and requirements, and the necessity for security (fig. 3). Grass or brush may have to be removed to prevent masking these aids.

(2) The pathfinder internal net radio 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 on 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.

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) normally is 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. These requirements normally will be covered by aviation unit *SOP*s 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 rotor 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 in order to allow helicopters to land in restricted areas. Whenever possible, it is desirable to land aircraft in the same formation in which they are flying (fig. 4). If a modification in flight formation is required for landing due to restrictions of the landing site, the change requiring the least shift of aircraft should be used.

(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 in order to load or unload personnel or supplies.

(6) *Approach and/or departure directions.* The directions 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 the tactical situation, or if it is desired to make maximum use of available landing area, most aircraft can land with a crosswind (10 knots or less) or a tailwind (5 knots or less). The same considerations apply to departure from a landing site.

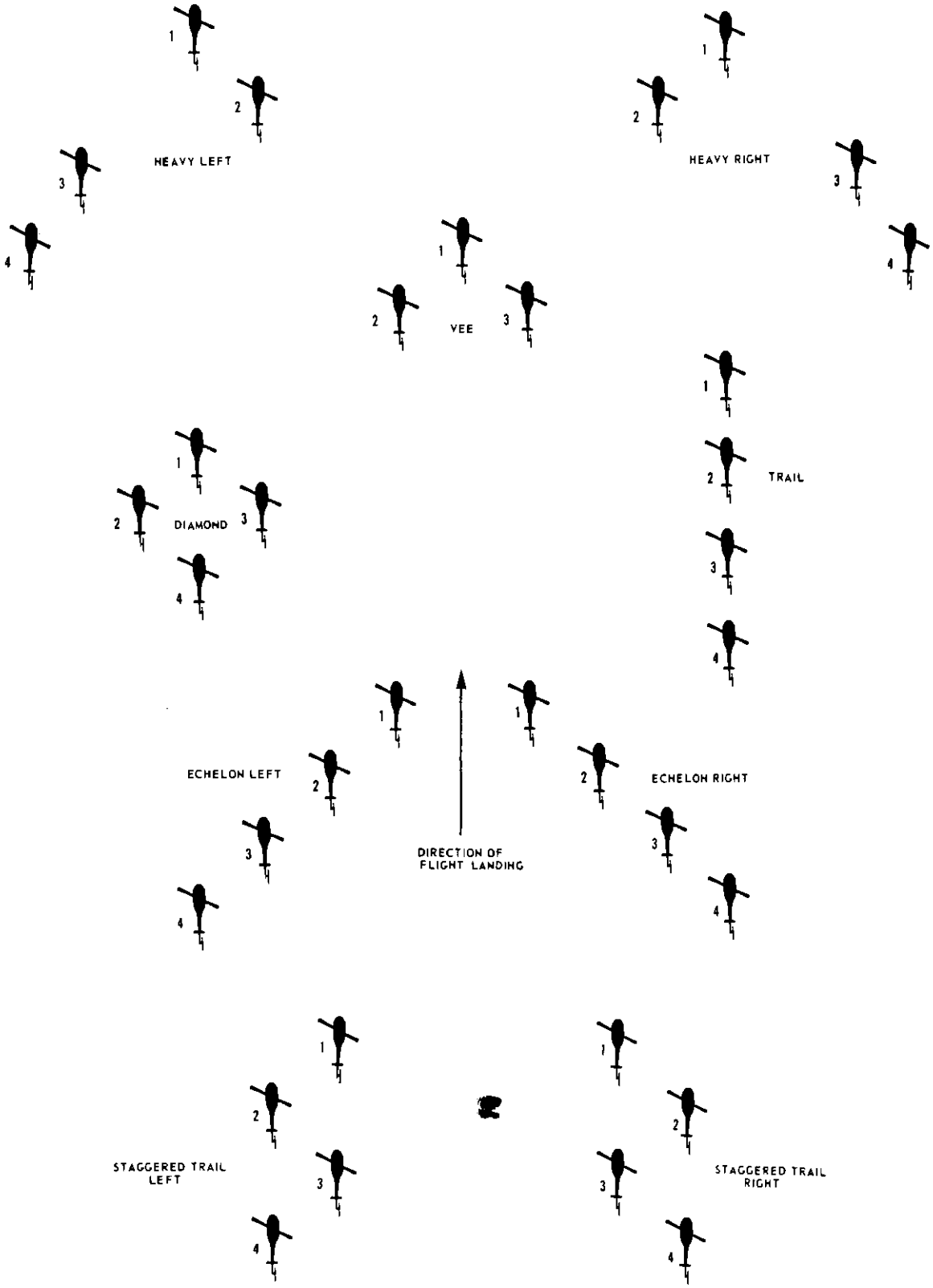


Figure 4. Standard flight and landing formations.

(7) *Prevailing winds.* Of the two factors —approach and/or departure routes (6) above, and prevailing wind—the best approach and/or departure route is the more important factor, unless the crosswind 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.

(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 area and better approach and/or 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, such as rocks, stumps, and holes that cannot be eliminated must be clearly marked (see para 29*b*(3)). For planning purposes, an obstacle ratio of 10 to 1 should be used; that is, 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 technical manuals. 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 *SOP*s 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 by the ground unit commander primarily to support the tactical plan. On the recommendations of the aviation unit commander and the pathfinder on the site, the ground commander or his representative decides when alternate sites will be used. Instructions concerning the use of alternate sites must be disseminated to pathfinders 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) must 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 are 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, if required, may perform the duties of any member of the site party. His most common additional duty is acting as the ground-to-air radio operator.

(2) The number of additional pathfinder personnel employed is dictated by the size of the landing site, the density of expected air traffic, the number and type visual and electronic aids to be used, and the tactical situation. Additional personnel operate the ground-to-air radio, the 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. If they are given a reconnaissance assignment, it should not include actual landing areas; these areas should only be reconnoitered by pathfinders.

29. Establishment of the Landing Site

a. Communications are established in the ground-to-air net and the 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 communication 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 obstalces 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). The 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 (such as, landing on a road), in order to reduce the danger of collision, especially at night.

(2) Normally, no landing zone marking is used during day operations, except smoke or other minimum identification means. Lanterns or field expedients are used to indicate the direction of landing and to mark individual landing points for a night operation (figs. 5, 6, 7, 8, and 9). Lights of different colors may be used to designate different helicopter sites or to separate flights within a larger formation. A lighted tee indicates the landing point of the lead aircraft of each flight 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 movement 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) Obstacles must be marked for daylight and night airmobile operations.

(*a*) During daylight airmobile operations, obstacles that may be difficult to detect and impossible to remove, such as wires, holes, stumps, and rocks should be marked with red panels or any other easily identifiable means.

(*b*) During night airmobile operations, red lights will normally be used to mark all obstacles within a landing site that cannot be easily eliminated. In most combat situations, it is impractical for security reasons to use red lights to mark the tops of these on the approach and departure ends of a landing zone. In a training situation, however, or in a rear area landing site, red lights should be used whenever possible. In the event that obstacles and/or hazards cannot be marked, aviators should be thoroughly advised of existing conditions by ground-to-air radio. In any case, the pathfinder landing site commander must insure that the most dangerous obstalces are marked first and eliminated, if possible at the earliest practicable time.

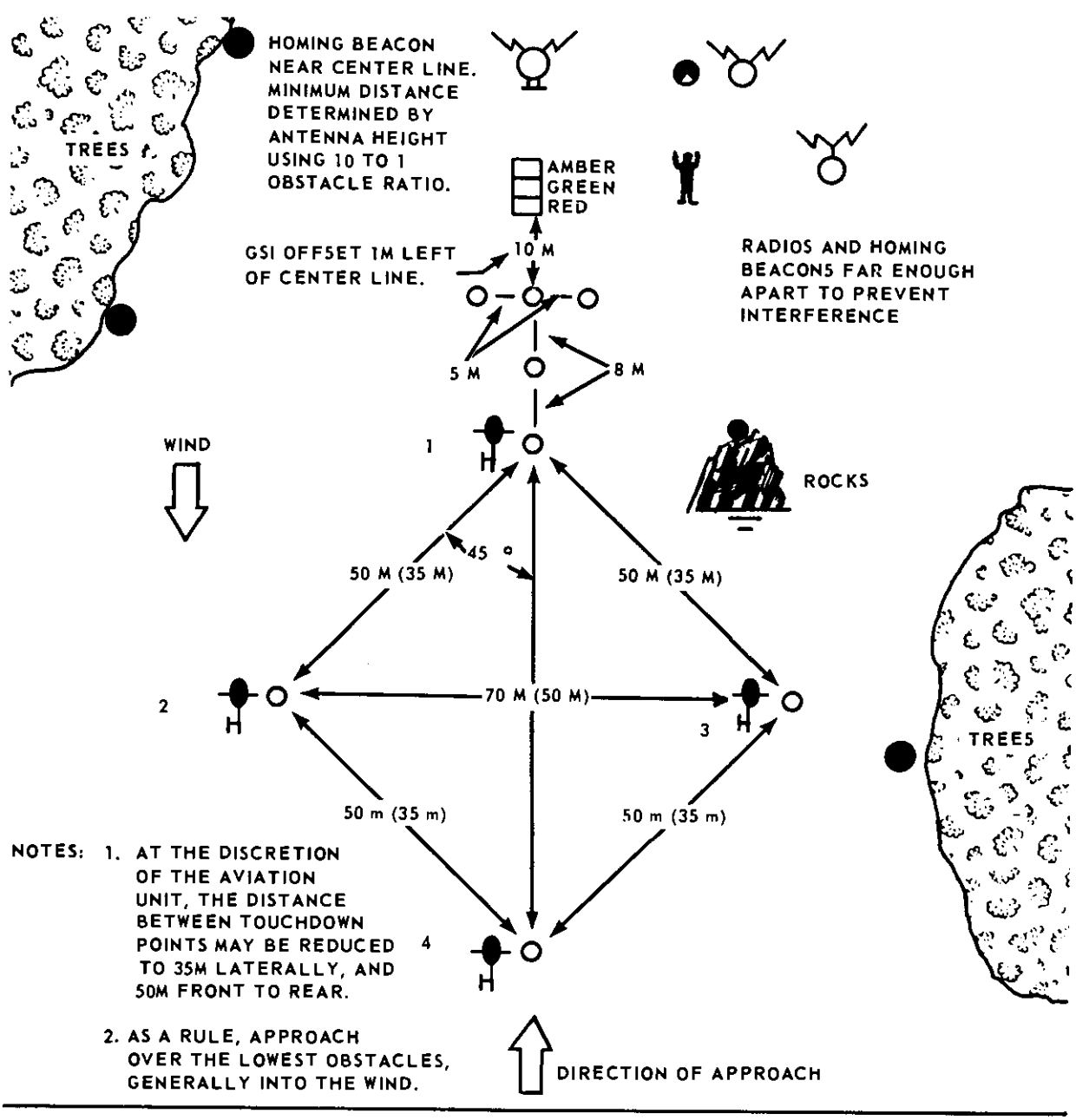


Figure 5. Night UH-1 landing site—diamond formation.

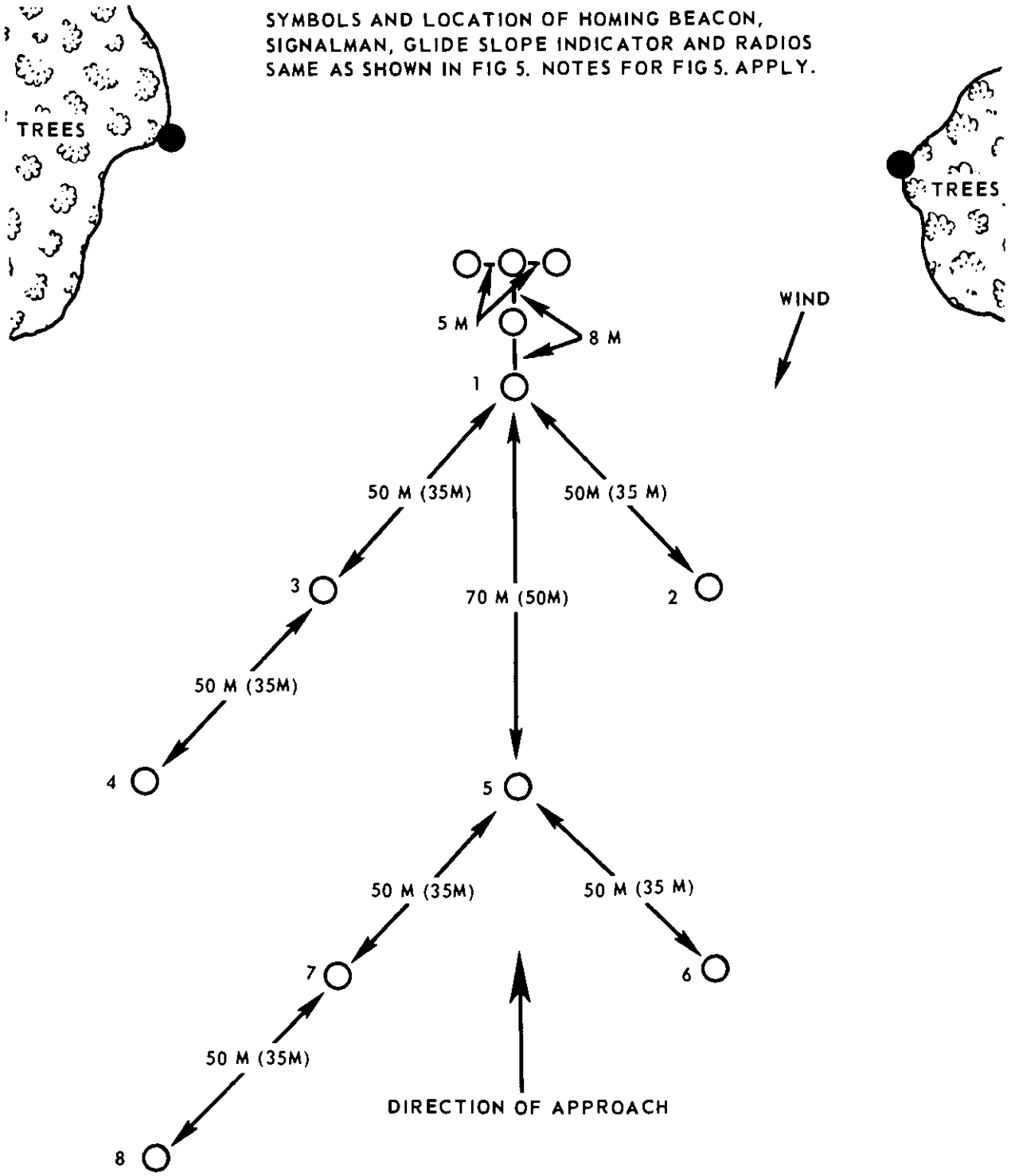


Figure 6. Night UH-1 landing site—flights heavy left formation.

(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 and clearing of the helicopter site quickly and efficiently. If unit assembly areas are to be used, they are

NOTES, SYMBOLS AND LOCATION OF HOMING BEACONS, RADIOS, GLIDE SLOPE INDICATOR SAME AS FIG. 5.

NOTE: DISTANCES BETWEEN PLATOONS MAY BE REDUCED TO 70 AND 105 M RESPECTIVELY AT DISCRETION OF AVIATION UNIT.

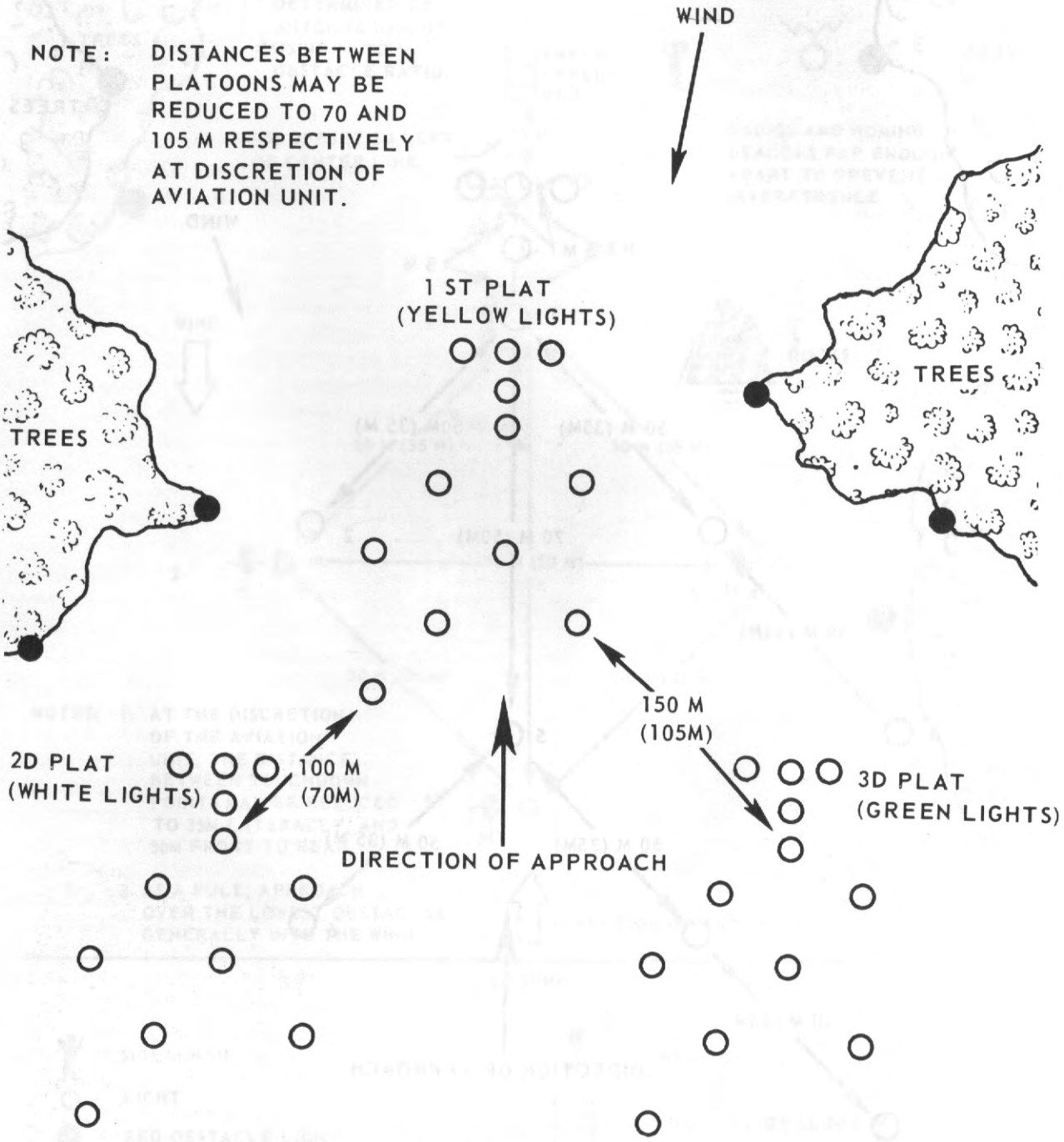


Figure 7. Night UH-1 landing site—company vee, flights heavy left.

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 and/or unloading opera-

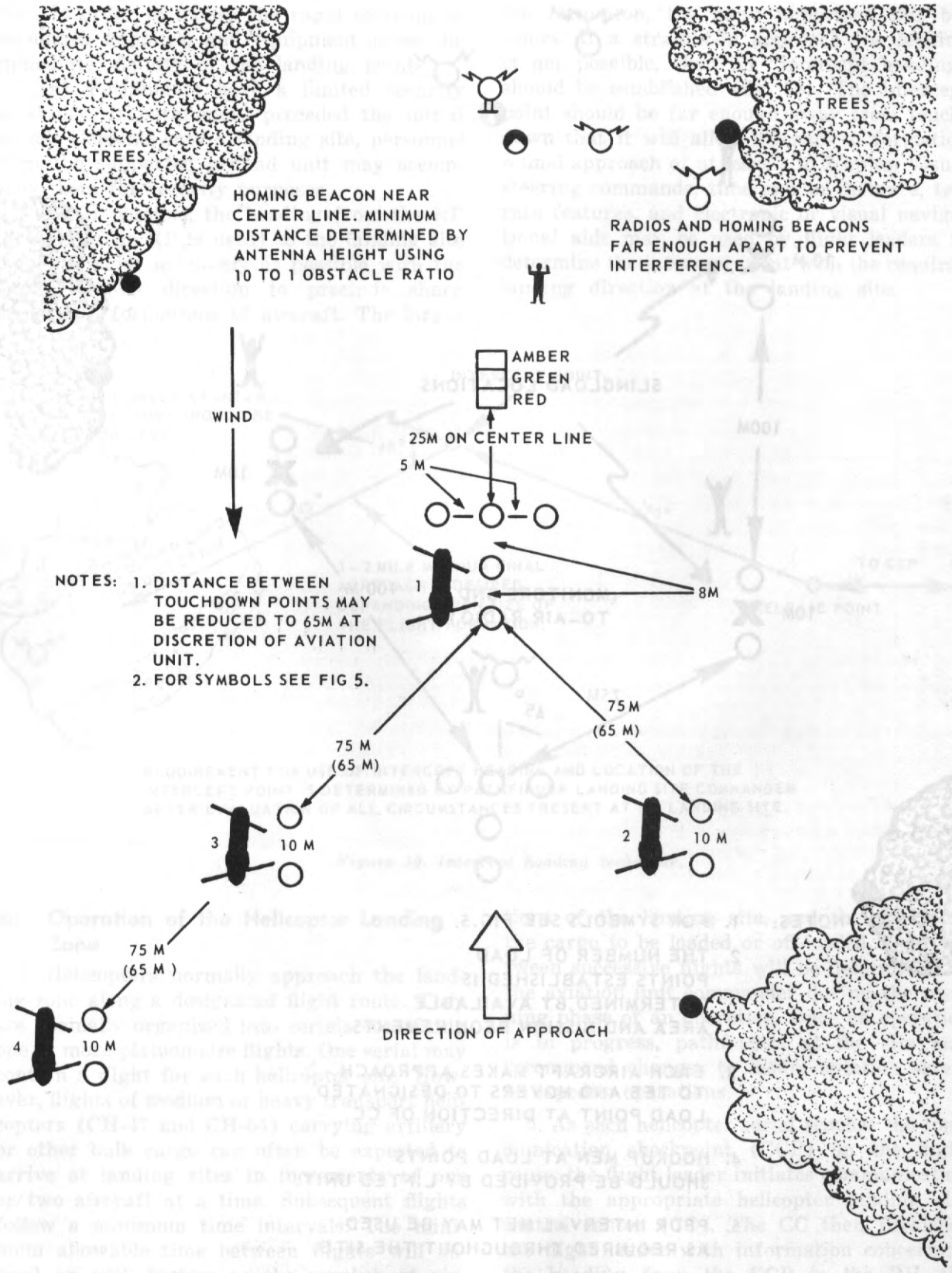
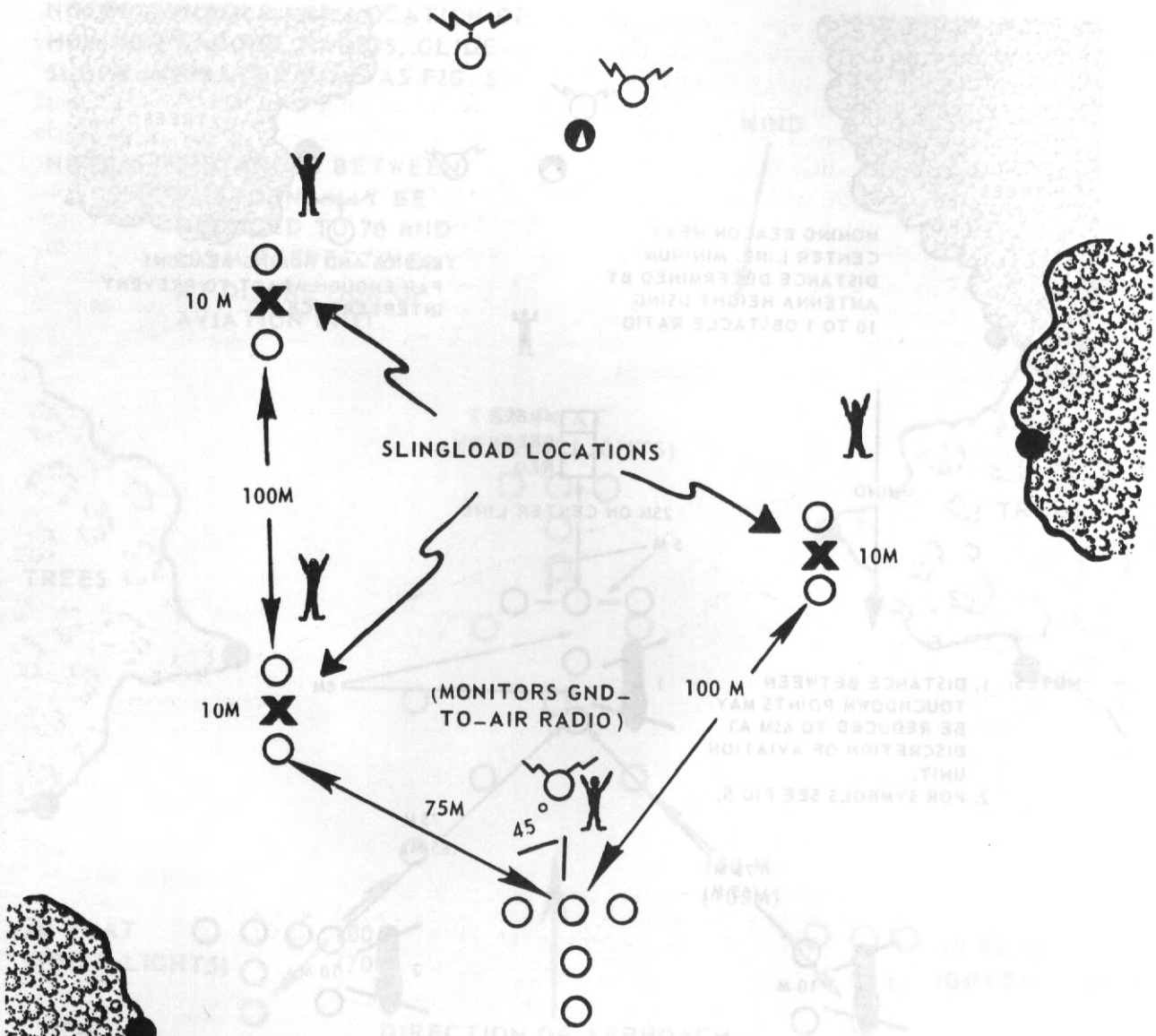


Figure 8. Night CH–47 landing site—heavy left formation.



NOTES:

1. FOR SYMBOLS SEE FIG. 5.
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 INTERVAL NET MAY BE USED AS REQUIRED THROUGHOUT THE SITE.

Figure 9. Night CH-47 slingload pickup and/or drop site.

tions in order to insure the rapid clearing 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 possible, the heading from the RP (or CCP if no RP is used) 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. 10). The intercept point should be far enough away from touchdown that it will allow aircraft in formation a final approach of at least 1 to 2 miles. Visual steering commands, time and/or 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.

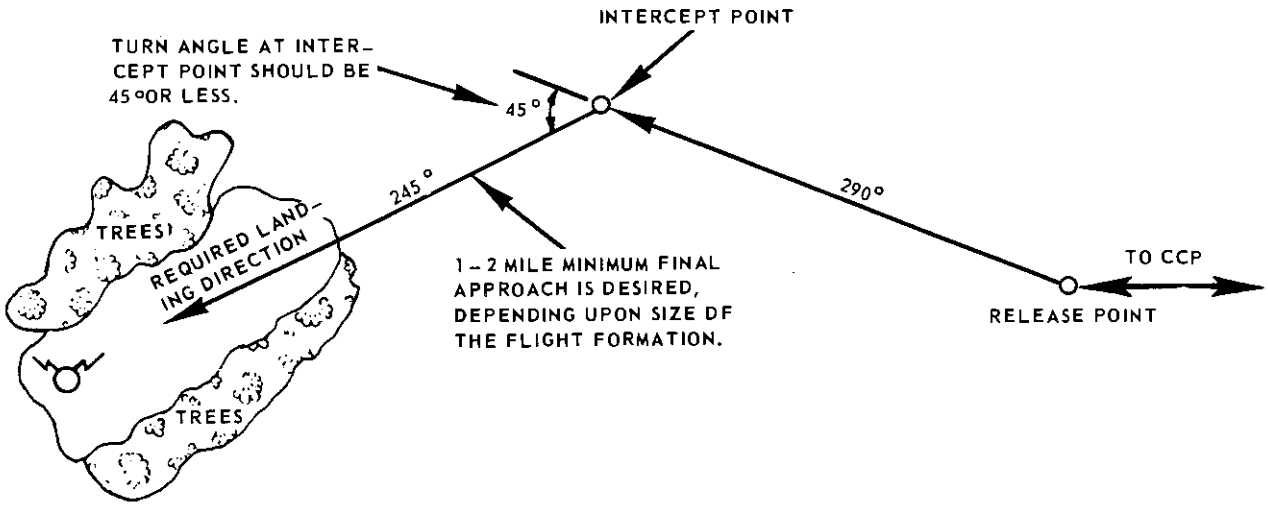


Figure 10. Intercept heading technique.

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 and 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 a minimum time intervals. The minimum allowable time between flights will depend on such factors as the number of aircraft per flight, the configuration and conditions of the landing site, and the nature of the 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 communication 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 the RP, the heading from the RP to the landing site, land-

ing direction, other pertinent information, such as the 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, 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.
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 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 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. This assistance is accomplished using visual signals, steering commands, or electronic homing techniques.

(1) For 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 mean DO NOT LAND or to indi-

cate 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 (app F) to assist in controlling the landing, hovering, or parking of helicopters.

31. Sling Loading Procedures

a. Helicopters are often employed to move cargo as external (sling) loads. This may be required in any of the following situations:

(1) When the cargo compartment of the helicopter is too small for the load.

(2) When the center of gravity limitation of the aircraft is exceeded by the characteristics of the load.

(3) When the maximum speed of loading and/or unloading is a requirement.

(4) When the conditions on the landing site prevent touchdown of the aircraft.

b. Pathfinders must be prepared to organize and control external load pickup or drop-off sites as an integral part of normal operations. Sling loads of artillery or other bulk cargo are routinely planned as a followup to airmobile assaults. The air traffic control procedures for sling load operations are basically the same as for airlanded operations. However, the pathfinder must be aware of the following considerations:

(1) A detailed load plan to include approximate weights and sequence of movement of loads should be provided by the supported unit to insure the correct and expeditious movement or placement of cargo.

(2) A larger area is often required for sling loading operations. Condition of the area, such as dusty surface and obstacles will often dictate the spacing of loads, the number of helicopters that can safely operate in the site simultaneously, and the overall speed of the operation.

(3) Rigging of the loads will normally be the responsibility of the lifted unit. However, pathfinders should check weight, rigging, and positioning of all external loads to insure aircraft safety.

(4) Ideally, signalmen and hookup men for individual loads should be provided by the lifted unit.

CHAPTER 5

AIRPLANE LANDING ZONES

32. General

a. 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.

b. Airplane landing zones are established so that Army airplanes may safely and expeditiously land and takeoff. The landing zone also provides guidance for airplane taxiing and parking while they are 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 landings simultaneously. The strip is marked visually (figs. 11 and 12), and it operates with much greater efficiency and safety when radio control is provided.

33. 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, which normally is good only for fair weather operation. This type of 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: not normally required.

b. Hasty. A hasty landing strip also has an unimproved surface, which is normally good for marginal weather, but is unusable 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 a control tower, hard surface runways, taxiways, and parking ramps.

Note. When it is anticipated that USAF troop carrier aircraft may use landing strips established by Army pathfinders thorough coordination must be effected with USAF and engineer elements to insure minimum safety requirements are met.

34. Selection of Airplane Landing Facilities

After a period of improvement, it is usually desirable that landing strips have taxiways, parking areas, and dispersal areas. Landing strips should be selected in areas where these installations can be established easily and yet 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

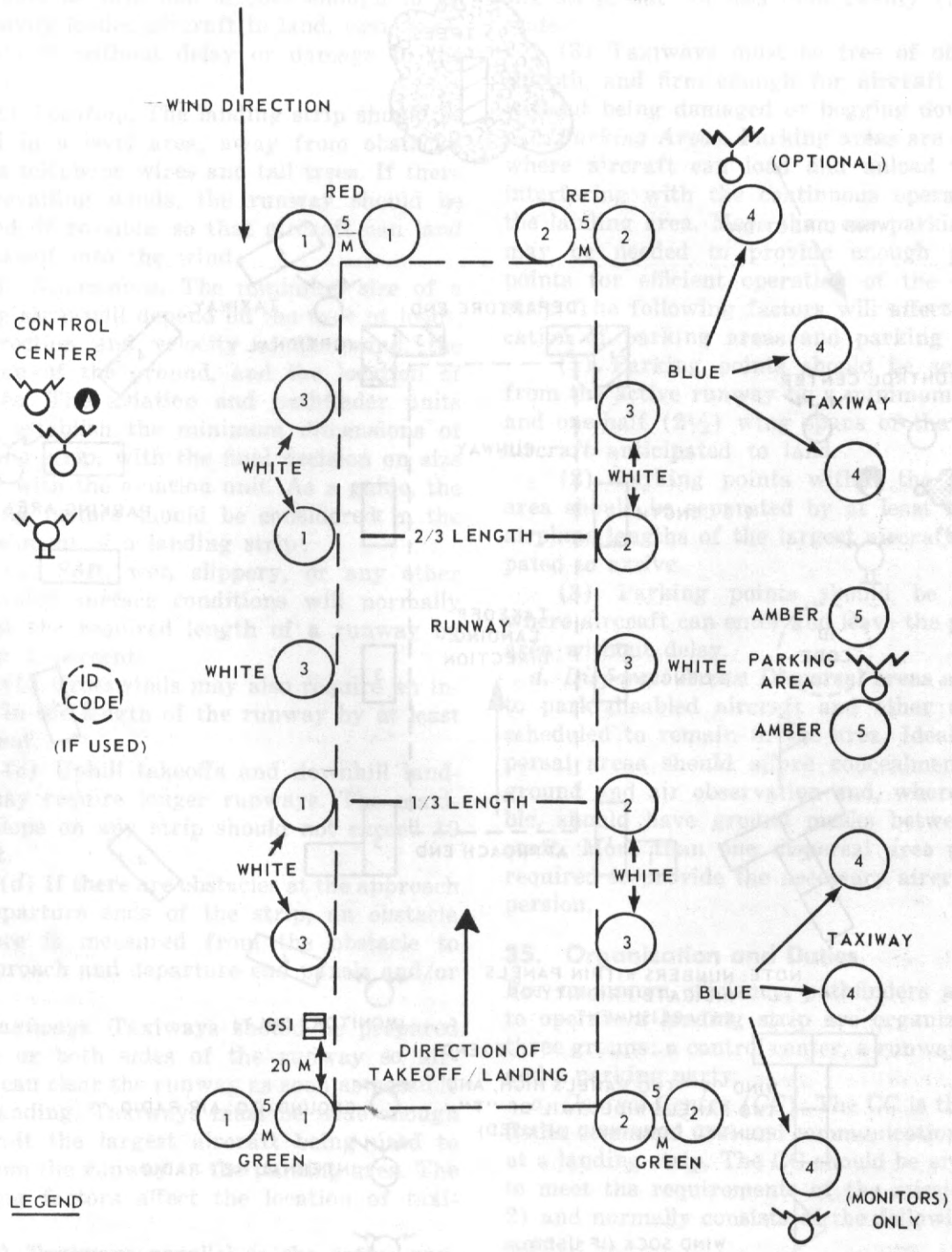


Figure 11. Airplane landing strip (night).

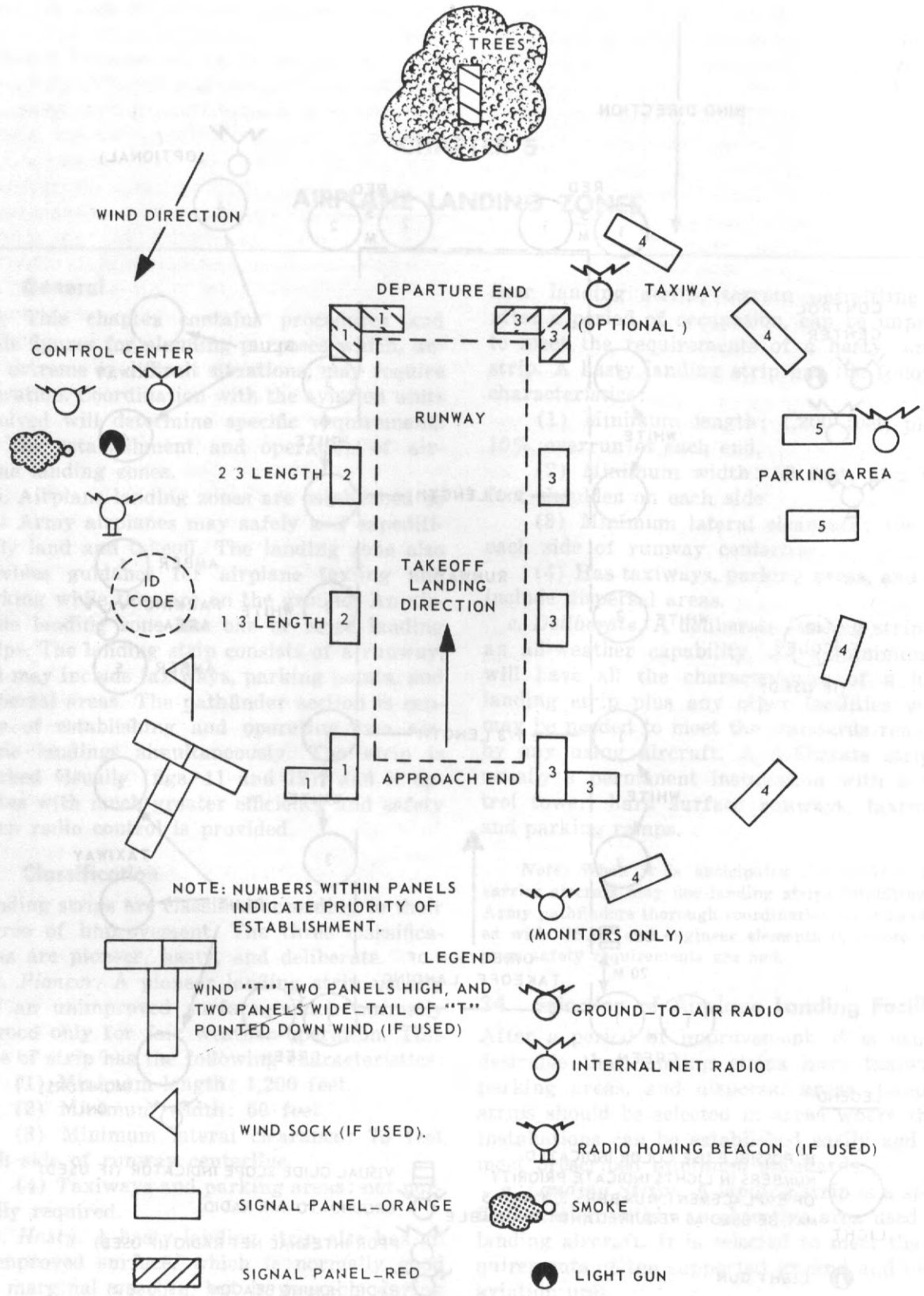


Figure 12. Airplane landing strip (day).

strip must be firm and smooth enough to allow heavily loaded aircraft to land, taxi, park, and takeoff 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, so that aircraft can land and takeoff into the wind.

(3) *Dimensions.* The minimum size of a landing strip will depend on the type of loads, the direction and velocity of the wind, the condition of the ground, and the location of obstacles. The aviation and pathfinder units jointly establish the minimum dimensions of a landing strip, with the final decision on size 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 percent.

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

(*c*) Uphill takeoffs and downhill landings may require longer runways. The maximum slope on any strip should not exceed 10 percent.

(*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 and/or 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 (2½) wing spans of the largest aircraft anticipated at the landing strip.

(2) The taxiways should be one and one-half (1½) 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 (2½) 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.

35. 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, in certain situations, also serves as the ground-to-air radio operator. He is responsible for—

(*a*) Designating and marking the exact limits of the landing strip.

(*b*) Clearing and maintaining the area within his capabilities.

(*c*) Insuring that safety procedures are observed.

(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 (app B) of aircraft arrivals, departues, 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 and/or 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 (as required), and furnishes information to the CC concerning the type of 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.

(2) Operate assembly aids as directed.

(3) Assist in the preparation of runways, taxiways, parking areas, and the removal or marking of obstacles.

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

36. Establishment of an Airplane Landing Strip

(figs. 11 and 12)

In establishing an airplane landing strip, each pathfinder element performs the following tasks:

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

b. Runway Party.

(1) Prepares the pathfinder internal net radio 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 he arrives at the landing strip location. He then selects and points out the exact loca-

tion, direction, and runway alinement to the runway party. The runway party 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, the left side of the runway is marked first and then the right side.

(3) If necessary and concurrent with marking, the runway party makes hasty improvements to the runway by filling holes and removing brush. It also removes or marks obstacles in the approach and departure zones as promptly as possible. (para 29*b*(3).)

(4) Pathfinders should be careful not to create obstacles on the runway such as erecting antennas and constructing field fortifications. They should keep personnel and equipment clear of the runway and taxiways in order not to obstruct these areas or to distract aviators.

c. Parking Party. The taxiways, the parking areas, and the dispersal areas are prepared in locations designated by the landing strip commander. The parking party prepares these areas simultaneously with the 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 and/or lights which face aviators as they taxi their aircraft.

(2) A parking point for each aircraft may be marked with a panel and/or light. Aircraft should be parked with the left wing over this panel and/or light. Parking arrangements should be preplanned and coordinated. Extraordinary care must be exercised in securing all panels to the ground. Firmly driven stakes are used to secure panels tautly; rocks piled on the corners of panels *will not* secure the panels properly.

37. Operation of an Airplane Landing Strip

a. General.

(1) Landing and takeoffs by large numbers of aircraft may present difficult control problems for pathfinders. Radio discipline must be strictly observed in order 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.

(2) The CC pathfinder internal net operator records flight arrival and departure times ad 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 30 seconds during the day and 1 minute at night. When departures are interspersed with landings, arriving aircraft should land at intervals separated by a minimum of 1 minute.

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

(3) As each flight or single aircraft reaches the communication checkpoint, the flight leader and/or aviator initiates communication with the CC by stating the flight's and/or 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 (app E). Instructions to individual aircraft are prefixed 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	Acknowledgement	RAIDER ONE, THIS IS PATHFINDER CONTROL;
	Heading (from CCP or A/C location, if required), traffic,	HEADING ONE FIVE ZERO, ENTER RIGHT TRAFFIC,
	Direction of landing	RUNWAY TWO SIX;
	Wind	WIND TWO FIVE ZERO DEGREES AT FOUR; ARTILLERY SOUTH OF THE STRIP FIRING ONE SEVEN ZERO, HEAVY HELICOPTER TRAFFIC ONE MILE EAST OF AIRFIELD, LOW LEVEL, RUNWAY CONDITION
	Other pertinent information (as required), such as enemy situation, friendly fires, traffic conditions, field elevation (at night only), obstacles, condition of runway	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 approaches 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 and/or final leg. Messages transmitted might be as follows:

Speaker	Topic	Message
Aviator	Location	PATHFINDER CONTROL, RAIDER ONE, TURNING RIGHT BASE.
Pathfinder	Acknowledgement	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 takeoffs are controlled by means of visual signals and aids (app F).

(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 temporarily clear all airborne aircraft from the immediate area. 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 (app F) 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 te 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 aircrat 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 takeoff, the aviator will request takeoff 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	*Message*	*Topic*
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 TAKEOFF.
Aviator	Confirmation	RAIDER ONE, ROGER.
Aviator (hold position)	Takeoff instructions	PATHFINDER CONTROL, RAIDER ONE, READY FOR TAKEOFF.
Pathfinder	Takeoff instructions	RAIDER ONE, PATHFINDER CONTROL; WIND TWO ZERO ZERO DEGREES AT FOUR, CLEAR FOR TAKEOFF.
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.* Selection of helicopter landing areas should be made in conjunction with the supported or using aviation unit. Consideration must be given to the type of helicopters and the purpose of the landing area, such as medical facilities, rearming and/or refueling points, troop loading and/or 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 re-

quired, landing areas may be designated by the use of a reference point (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, be 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 of 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. They should 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 existing safety regulations pertaining to the type of helicopter, the terrain, or the 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 aircaft, aviators request permission from the pathfinder air traffic controller. Helicopters may takeoff in any direction, consistent with safety requirements, in order to expedite air traffic. Clearance to takeoff may be given to helicopters and airplanes concurrently, provided the terrain and situation permit.

CHAPTER 6

DROP ZONES

38. 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.

39. 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—

(1) Prepare and place the panels (lanterns) that form the code letter.

(2) Prepare and place the flank panel (lantern and signal light) and far panel (lantern and signal light).

c. The CC is organized and operated as described in Chapter 3. If considered necessary, the supported aviation unit may establish a release point.

40. 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 the—

(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: 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 × 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 × 90 equals 45.9).

T equals 8 seconds

D equals 45.9 × 8 equals 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 *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 × 105 equals 53.55 or 54). Applying the formula *T* equals *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.

41. 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 × 5 × 10 or 130 meters.

42. 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, with the top of the flank panel alined 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 the 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 4 lights high, 3 lights wide, with 5 meters between lights. Light guns 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.

43. 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*, the 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 in order 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 in order 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.

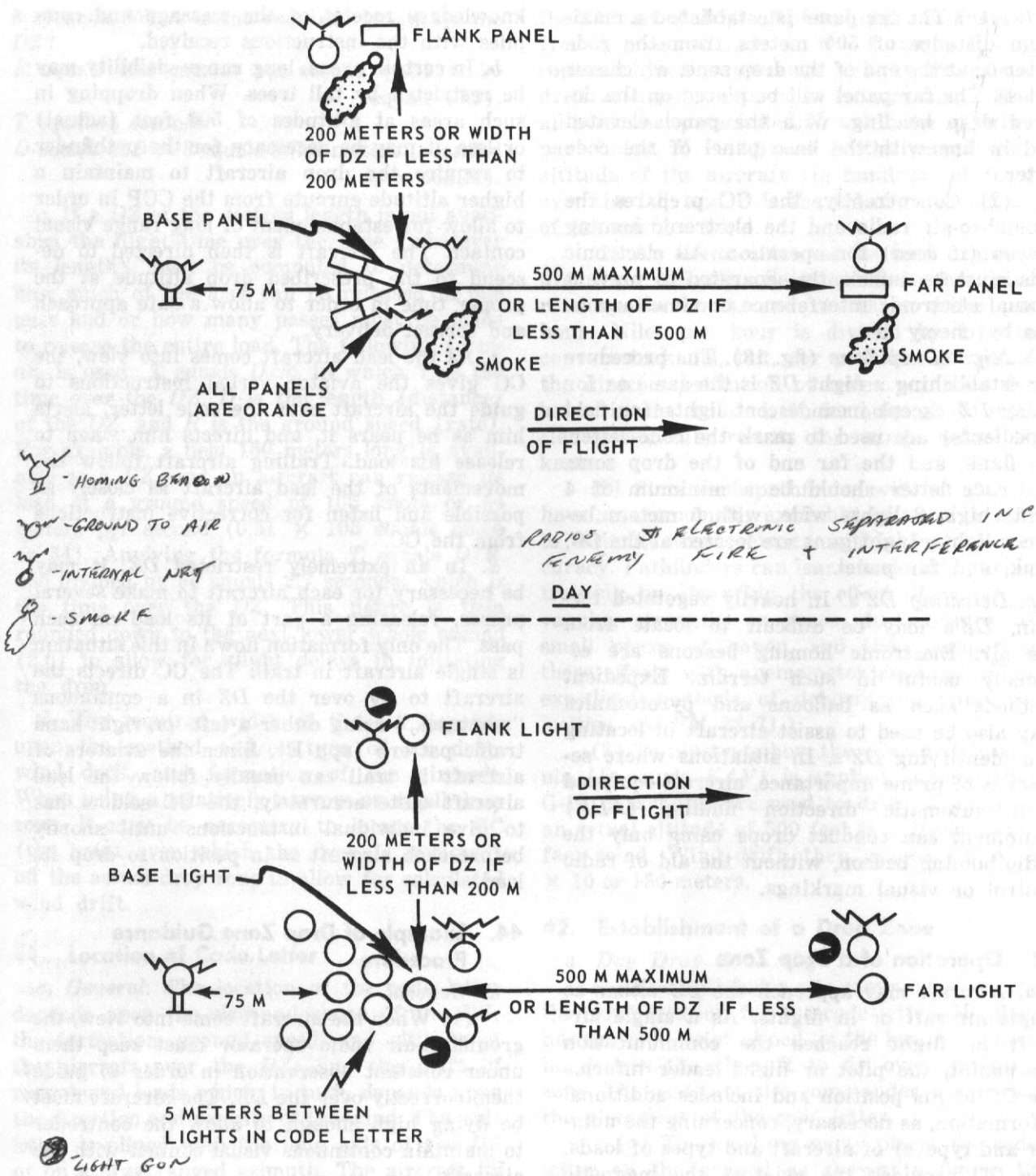
d. In an extremely restricted *DZ*, it may be necessary for each aircraft to make several passes, releasing a part of its load on each pass. The only formation flown in this situation is single aircraft in trail. The CC directs the aircraft to fly over the *DZ* in a continuous "racetrack," using either a left- or right-hand traffic pattern (app E). 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.

44. Example of Drop Zone Guidance Procedure

a. General.

(1) When the aircraft come 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.



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.

(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 correct approach and delivery. In such situations the aviator will aline the aircraft with the code letter and the far panel. Smoke (or a light gun 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 light gun 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, STANDBY (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 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 "standby" and the command to drop by the CC. The command "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 come into sight and approach 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, STANDBY.

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 come into sight and approach 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, STANDBY.

DZ control: 178, EXECUTE! EXECUTE! EXECUTE!; ENTER LEFT (RIGHT) TRAFFIC, REPORT FINAL.

Avator: 178, ROGER.