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FM 1-100

DEPARTMENT OF THE ARMY FIELD MANUAL

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ARMY AVIATION



HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1959

FIELD MANUAL }
No. 1-100

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 3 April 1959

ARMY AVIATION

	Paragraphs	Page
PART ONE. INTRODUCTION		
CHAPTER 1. PURPOSE AND SCOPE.....	1, 2	5
2. MISSION AND BASIC OBJECTIVES OF ARMY AVIATION.....	3, 4	6
3. COMMAND AND STAFF RESPONSIBILITIES.....	5-11	7
PART TWO. MISSION CAPABILITIES		
CHAPTER 4. COMMAND, LIAISON, COURIER, AND COMMUNICATIONS		
Section I. Command and liaison.....	12-15	12
II. Column control.....	16-18	13
III. Message drop and pickup.....	19-21	14
IV. Messenger and courier service.....	22-27	15
V. Wire laying.....	28, 29	17
VI. Radio relay.....	30-32	18
VII. Propaganda dissemination.....	33-35	19
VIII. Audio means of communication.....	36-39	19
IX. Training for aviation support missions.....	40-42	20
CHAPTER 5. AIRLIFT OF ARMY PERSONNEL AND EQUIPMENT		
Section I. Airlift for troop movement in the combat zone.....	43-45	22
II. Training for aerial troop movement.....	46, 47	25
III. Rapid movement of supplies in the combat zone.....	48-51	26
IV. Training for aerial movement of supplies.....	52, 53	28
CHAPTER 6. AIR MOBILITY FOR LAND RECON- NAISSANCE		
Section I. Aerial combat reconnaissance.....	54-57	30
II. Air delivered reconnaissance elements.....	58-72	31
III. Training for air delivery of reconnaissance elements.....	73-75	38
CHAPTER 7. OBSERVATION, RECONNAISSANCE, AND SURVEY		
Section I. Aerial observation.....	76-86	39
II. Observer training.....	87-92	44
III. Aerial reconnaissance.....	93-104	46
IV. Aerial photography.....	105-113	51
V. Aerial surveillance.....	114-116	57

*This manual supersedes FM 20-100, 25 February 1952, including C 1, 14 May 1953; and TC 1-9, 29 August 1958.

	Paragraphs	Page
Section VI. Target acquisition.....	117, 118	58
VII. Conduct of fire.....	119-122	61
VIII. Camouflage inspection.....	123-125	63
IX. Topographical survey.....	126-131	64
X. Artillery survey operations.....	132, 133	67
XI. Radiological survey.....	134, 135	68
CHAPTER 8. COMBAT ZONE CASUALTY EVACUA- TION		
Section I. General.....	136, 137	69
II. Army Medical Service aerial ambulance units.....	138-141	69
III. Additional aeromedical evacuation means.....	142-145	72
IV. Aeromedical evacuation operations.....	146, 147	73
V. Training for aeromedical evacuation.....	148, 149	74
PART THREE. EMPLOYMENT		
CHAPTER 9. GENERAL		
Section I. Basic principles of employment.....	150-159	75
II. Important factors in employment.....	160-168	77
CHAPTER 10. TACTICAL EMPLOYMENT		
Section I. General.....	169-171	79
II. Employment in offensive operations.....	172-176	80
III. Employment in defensive operations.....	177-180	87
IV. Employment in retrograde operations.....	181-183	93
V. Nuclear aspects of employment.....	184-192	94
CHAPTER 11. DEFENSE OF AIRCRAFT.....	193-203	99
PART FOUR. OPERATIONS		
CHAPTER 12. NIGHT OPERATIONS		
Section I. General.....	204-206	105
II. Airfields.....	207, 208	106
III. Navigation.....	209-211	106
IV. Night observation.....	212-216	108
V. Night aerial photography.....	217-219	111
CHAPTER 13. SPECIAL OPERATIONS		
Section I. General.....	220, 221	114
II. Airborne operations.....	222-229	114
III. Amphibious operations.....	230-237	118
IV. Jungle operations.....	238-246	120
V. Mountain operations.....	247-253	123
VI. Desert operations.....	254-259	124
VII. Operations in snow and extreme cold.....	260-265	126
VIII. Operations against guerilla forces.....	266-270	128
IX. Operations in support of guerilla forces.....	271-274	129
CHAPTER 14. COMMUNICATIONS AND AIR TRAFFIC CONTROL		
Section I. Communications.....	275-280	133
II. Communication security.....	281-284	140
III. Air traffic control.....	285-289	142
CHAPTER 15. ARMY AIRFIELDS AND LANDING AREAS		
Section I. General.....	290-292	146
II. Reconnaissance.....	293, 294	147
III. Site selection.....	295-307	148
IV. Instrument approach factors.....	308, 309	153
V. Occupation and organization.....	310-313	154

	Paragraphs	Page
Section VI. Seaplane facilities.....	314-319	157
VII. Lighting.....	320, 321	163
VIII. Security.....	322-324	165
CHAPTER 16. TRAINING		
Section I. Responsibility.....	325-327	168
II. Management.....	328-333	169
III. Essential training phases.....	334-340	171
CHAPTER 17. INTELLIGENCE, EVASION, AND ES-CAPE	341-345	176
18. SEARCH AND RESCUE OPERATIONS		
Section I. Basic considerations.....	346, 347	179
II. Search and rescue operations.....	348-351	180
III. Methods of search.....	352-356	182
CHAPTER 19. CRASH RESCUE AND FIREFIGHTING PROCEDURES		
Section I. Organization and training.....	357-361	187
II. The crash-rescue plan.....	362, 363	188
PART FIVE. SERVICE AND SUPPORT		
CHAPTER 20. AVIATION MEDICINE.....	364-369	190
21. AVIATION SUPPLY		
Section I. General.....	370-374	193
II. Supply procedures.....	375-382	196
CHAPTER 22. AVIATION MAINTENANCE		
Section I. General.....	383-385	199
II. Maintenance category responsibilities.....	386-388	201
III. Aircraft maintenance inspections.....	389, 390	204
CHAPTER 23. GROUND HANDLING AND MOORING.....	391-396	206
APPENDIX I. REFERENCES.....		210
II. AIRCRAFT IDENTIFICATION.....		213
III. AVIATION ANNEX TO DIVISION SOP.....		214
IV. AVIATION ANNEX TO OPERATIONS ORDER.....		218
V. AERIAL PHOTOGRAPHY.....		220
VI. FILMING PROCEDURES.....		233
VII. RADIOLOGICAL SURVEY PLAN.....		235
VIII. INTERIM AERIAL SURVEY PROCEDURES.....		237
IX. SAMPLE REQUEST FORM FOR AIRCRAFT FLARE EMPLOYMENT.....		242
X. CHARACTERISTICS OF AIRCRAFT FLARES.....		243
XI. AIR-GROUND PANEL CODES.....		244
XII. FIRE REQUESTS.....		248
XIII. TECHNICAL CHARACTERISTICS OF ARMY AVIATION AVIONIC EQUIPMENT.....		249
XIV. HAND SIGNALS.....		255
XV. AIRCRAFT TRANSPORTATION.....		261
XVI. RESUPPLY EQUIPMENT AND TECHNIQUES.....		270
XVII. MESSAGE DROP AND PICKUP METHODS AND TECHNIQUES.....		276
XVIII. WIRE LAYING EQUIPMENT AND TECHNIQUES.....		280
XIX. HELICOPTER EXTERNAL LOAD OPERATIONS.....		284
INDEX.....		344

PART ONE

INTRODUCTION

CHAPTER 1

PURPOSE AND SCOPE

1. Purpose

This manual is a guide for commanders, staff officers, Army aviators, and other Army personnel concerned with the employment of Army aircraft, the organization and planning of Army Aviation units, and the training of aviation personnel.

2. Scope

a. The contents of this manual are broad in scope and apply to all Army Aviation units regardless of the type aircraft with which equipped. It covers missions and basic principles, methods of employment, operations, and the various service and support functions associated with Army Aviation.

b. Technical data is limited to essentials. Complete technical and administrative data are contained in other official publications cross-referenced in the text and listed in appendix I. Additional appendixes in this text cover particular forms and procedures useful in expediting or fulfilling aviation requirements.

c. The material presented herein is applicable to nuclear or non-nuclear warfare.

CHAPTER 2

MISSION AND BASIC OBJECTIVES OF ARMY AVIATION

3. Mission

The mission of Army Aviation is to augment the capability of the Army to conduct effective combat operations. This mission includes:

- a.* Expediting and facilitating the conduct of tactical operations on land.
- b.* Improving mobility, command, control, and logistic support of Army forces.
- c.* Providing greater maneuverability under conditions of nuclear warfare.

4. Basic Objectives of Army Aviation

a. Mobility. Army Aviation will, within its capabilities, provide a means of achieving maximum mobility for Army ground forces. These capabilities of Army Aviation provide the ground commander with the ability to move forces and equipment with great speed, virtually unaffected by obstacles.

b. Flexibility. Inherent flexibility and immediate responsiveness of Army Aviation units in support of a combat force allows the ground commander to rapidly shift, redirect, or mass his forces as necessary.

c. Freedom of Utilization. Freedom of utilization permits a commander to employ organic, attached, or supporting Army Aviation units in the way which contributes most to the successful accomplishment of his mission.

d. Immediate Availability. Immediate availability increases the value of Army Aviation to the ground commander. Availability is facilitated by flexible organization, mobility, proper utilization and maintenance of aircraft, and proper priority scheduling of missions.

e. Integrity of Command. Integrity of command increases the effectiveness of Army Aviation in combat. This objective implies that control is vested in a single individual at each command echelon. Higher echelons of command exercise no greater control over aviation in subordinate units than they would normally exercise over weapons and vehicles of these units.

CHAPTER 3

COMMAND AND STAFF RESPONSIBILITIES

5. Command Responsibility

Organic or attached Army Aviation units provide the tactical commander with combat support. Maximum use of these aviation units can be accomplished when the tactical commander understands their mission, capabilities, and employment techniques and has established definite command and operational control policies for their inclusion in the operational plan of action. Such planning should normally include temporary staff assignment of Army aviators to ground units during early tactical training. As qualified branch officers, Army aviators may perform a dual role if necessary. Availability of an aviation staff officer gives the tactical commander an experienced advisor in a technical military field and assures full utilization of Army Aviation's characteristic advantages of speed, flexibility, and a relatively large scope of action. An effective and continuous training program for aviation units is a continuous command responsibility.

6. Mission Assignment and Employment

a. General. Missions of Army Aviation are normally initiated and assigned directly by the commander of the parent or supported tactical unit. The missions are based on the commander's plans and decisions. Under special circumstances, as indicated below, higher headquarters may impose limitations on the employment of aircraft or prescribe certain missions to be accomplished on behalf of the force as a whole.

b. Limitation by Higher Headquarters. Tactical situations may arise wherein higher headquarters will restrict, in varying degrees, the activity of subordinate units' use of aircraft. Typical situations justifying restrictions include the following:

- (1) Numerous units operating in a sector so narrow that unlimited aerial operations could create excessive flying hazards or result in unnecessary duplication of effort.
- (2) Secrecy requirements of paramount concern to prevent disclosure of important tactical moves; e.g., the maintenance

of normal appearances during a relief in combat or during a buildup of strength.

(3) Lack of required logistical support.

c. Missions Prescribed by Higher Headquarters. Higher headquarters may prescribe missions for subordinate echelon aviation units on behalf of the force as a whole. Such directed missions may be ordered on either a one-time-only or a recurrent basis; they may be scheduled as to time or place or both, or they may be on call. The following are illustrative examples of directed missions:

- (1) Higher headquarters requires, either for its own use or for one of its units without organic aviation, specific information concerning an area known to be covered by a subordinate unit's aviation; it may direct the subordinate unit to perform the mission.
- (2) In a stabilized situation or on a narrow front, when it would be wasteful of effort for all units to maintain simultaneous aerial surveillance, the responsibility for observation may be allocated equitably among all units pursuant to a coordinated time schedule.
- (3) A heavily committed frontline unit has indicated to higher headquarters its need for reinforcement or relief aviation.

A reserve unit may be directed to fulfill such requirements.

d. Request for Additional Aircraft. When a commander desires additional aircraft to support his unit, he will normally make a request for them through command channels. For divisional units, requests for tactical requirements will usually go to the division aviation officer who will advise the division commander on the availability of additional aircraft and recommend the priority for fulfilling the request. If the request is for aircraft organic to corps or army, it will then be forwarded through command channels to the appropriate headquarters. Logistical air transport requirements normally go to the division transportation officer who in conjunction with the aviation officer coordinates these requirements with capabilities of available organic, attached, or direct support Army aviation. Request for air evacuation of casualties is covered in paragraph 146.

7. Aviation Special Staff

Army Aviation special staff sections are provided for division and higher headquarters. In addition to performing those functions prescribed in FM 101-5, these staff sections normally supervise Army Aviation matters within the command including technical aspects of administration, training, and operations.

a. Aviation Staff Officer. The aviation staff officer is charged with all special staff responsibilities pertaining to Army Aviation opera-

tions within the command. He may, in the name of the commander, exercise operational control of all organic, attached, or supporting aircraft operating units which have not been assigned or attached to subordinate units within the command.

b. Liaison. The aviation staff section maintains liaison with aviation staff sections of higher and lower levels of command and with adjacent units. It is responsible for coordination, at appropriate level, of Army Aviation operations with other arms and services including air traffic control and air defense agencies.

c. Tactical Planning. The aviation staff section assists the general and special staff section in preparing Army Aviation portions of estimates, plans, orders, and reports.

d. Training Supervision. The aviation staff section supervises unit aviation training for effective utilization.

8. Staff Duties

Army Aviation staff duties are similar at division, corps, and army command levels. Differences arise from increased scope of operations at the higher levels of command. Duties include—

a. Inspecting personnel flight records and flight rating and status orders.

b. Supervising aircraft accident investigation and reporting.

c. Supervising flying evaluation boards, suspensions from flying, and restoration to flying duty.

d. Coordinating qualification and procurement of aviation personnel.

e. Prescribing and examining requirements for pilot flight qualification and proficiency.

f. Establishing technical training programs and conducting unit schools.

g. Insuring compliance with standardized operational and organizational maintenance procedures for new aircraft and equipment as established by heads of technical services, in accordance with AR 750-5.

h. Supervising training procedures for traffic control, navigation, communication, identification, and safety.

i. Supervising flight proficiency and aviation tactics training.

j. Advising, supervising, and directing, where appropriate, the employment of aviation including fixed wing and rotary wing aircraft.

k. Monitoring the employment of aviation within the command and integrating aviation effort.

l. Developing evasion and escape plans and techniques with recommendations for their implementation.

m. Advising the commander and staff on technical aspects concerning capabilities, limitations, and operational characteristics of Army aircraft, and establishment and improvement of airfields.

n. Advising the commander and staff on Army Aviation doctrine, tactics, and techniques.

o. Coordinating the use of common aviation facilities such as airfields, night lighting, and navigational aids.

p. Prescribing in-flight control and interservice coordination of same.

q. Developing, coordinating, and disseminating essential flight information.

r. Preparing recommendations to the appropriate technical service on requirements for and the distribution of aircraft and allied equipment.

9. Staff Estimates and Recommendations

The aviation staff officer makes a continuous estimate of the tactical situation. He formulates plans for the employment of available aviation, and makes recommendations to the tactical commander. Factors particularly affecting Army Aviation which must be considered include the following:

a. *Tactical Situation.* This includes friendly and enemy dispositions, with special emphasis on the location of opposing frontlines, known locations of artillery and air defense installations, and recent enemy air activity.

b. *Terrain and Weather.* This includes available locations for airfields, cover and concealment for aircraft and personnel, the probable effect of weather on flying, and conditions of visibility.

c. *Status of the Aviation Unit.* The aviation unit's strength in personnel and equipment, state of training, and supply status (especially fuel, lubricants, and spare parts) must be considered.

d. *Enemy Capabilities.* Interference with the aviation unit's ground installations or with its aircraft in flight must be considered.

e. *Scale of Use of Atomics.* To determine risks and the allowable pattern of operations, the scale of use of atomics must be carefully evaluated. See also paragraph 184.

10. Staff Coordination

Staff coordination should be accomplished as outlined in FM 101-5.

11. Aviation Units

a. In assigning duties to his leaders, the unit aviation commander considers their individual capabilities and personalities and develops a high degree of initiative and personal responsibility. One of the

most important means of accomplishing this is by habitual dispersal and decentralization of personnel and equipment.

b. He will normally request attachment of intelligence specialists for specific operations in which their assistance will be effective.

c. Aviation officer assignments may include the following as additional duties:

Assistant operations officer.

Technical supply officer.

Assistant maintenance officer.

Instrument flight instructor.

Instrument flight examiner.

Liaison officer.

Instructor pilot.

Test pilot.

Crash and rescue supervisor.

Accident investigator.

PART TWO
MISSION CAPABILITIES
CHAPTER 4
COMMAND, LIAISON, COURIER, AND
COMMUNICATIONS

Section I. COMMAND AND LIAISON

12. General

The destructive power of modern weapons requires wide dispersion of units. Dispersion increases the need for effective liaison between units without excessive loss of time. Army Aviation affords the best means of achieving this type liaison.

13. Command and Staff Officers

a. By utilizing Army aircraft, command and staff officers can make timely and frequent visits to subordinate units. From an aerial vantage point, they are in position to watch the progress of an operation and, as the need arises, move rapidly to critical points to personally influence the action.

b. Aircraft are used to assemble commanders and staff officers from widely dispersed locations for command and staff conferences and briefings.

14. Liaison

Army aviation provides Army units with a rapid means of effecting direct liaison with other units. By utilizing Army aircraft, visits over extended distances can be accomplished to allow coordination between technical support agencies and their support units, between units engaged in joint operations, and any other actions of this nature requiring direct liaison visits.

15. Choice of Aircraft

The choice of aircraft for command and liaison functions will depend upon the situation. Under visual flight conditions, the following rules serve as a guide:

a. Use fixed wing aircraft when—

- (1) Relatively long distances must be flown.
- (2) Adequate landing strips are available.

b. Use rotary wing aircraft when—

- (1) Relatively short distances are to be flown.
- (2) Adequate landing strips are not available.
- (3) A wide range of airspeeds is desired.
- (4) Visibility is limited and/or low ceilings exist.

Section II. COLUMN CONTROL

16. General

The battlefield commander seldom exercises the degree of control he desires. This is particularly true in march formations or in envelopments in which control of movement is complicated and must be carefully supervised. Aerial observation provides the commander with radio and visual contact with all elements under his command. Column control is best accomplished from a rotary wing aircraft (fig. 1).



Figure 1. Sioux helicopter controlling a tank column, 1952.

17. Control of Ground Vehicles From the Air

A primary requisite to the aerial control of vehicular movement is the ability to identify the particular vehicle, tank, serial, or convoy from the air. Vehicle marking will be governed by SOP. Use of panels, pyrotechnics, and other devices for day and night identification will normally be included in SOI's.

a. Radio communication is the normal means of contact between the aerial vehicle employed by the commander and his ground unit. However, extensive use may be made of message drop and visual signals during periods when radio silence is imposed.

b. The homing capability of FM radio equipment installed in Army aircraft facilitates the location of radio vehicles which may have been lost or which may have dropped out of the column. Specialized maintenance personnel and spare parts needed to repair vehicles may also be flown in by aircraft. Additional personnel and weapons needed to protect disabled vehicles may also be flown in, usually by rotary wing aircraft.

18. Control of Ground Troops From the Air

Commanders may incorporate Army aircraft as an additional means of control for coordinated ground attacks upon an objective. Aerial observation of the overall progress of the attack affords reliable information on which to base a decision to shift or lift supporting fires. The same homing capability mentioned in vehicle control (par. 17) may be used to locate friendly patrols. CP's and vehicles utilized by key officers may bear individual markings distinguishable from the air to expedite their location within the column or along the line of contact.

Section III. MESSAGE DROP AND PICKUP

19. General

Message drop and pickup supplements communications between air observers and ground units of forward field echelons, between ground units in special situations, and in emergency between aircraft and a ground unit or headquarters. Since this method is at times the only means of communications, training for message drop and pickup techniques should be included in the advanced individual training phase for all military personnel.

20. Message Drop

The airdrop of messages can be employed as a normal messenger service on either a scheduled or unscheduled basis. It may also be used as an alternate or emergency means of air to ground communications to advise units of ambushes, obstacles, concentrations of

enemy forces, or other intelligence of immediate importance. To use aircraft for this mission, a minimum of additional equipment is required and, if necessary, this media of communication can be improvised and employed on very short notice without prearranged procedures or site preparation. Techniques and procedures for message drop are described in appendix XVII.

21. Message Pickup

As in the airdrop of messages, the pickup of messages by aircraft in flight can be employed on either a scheduled or unscheduled basis, but prearrangement is necessary to coordinate the operations between the aircraft and ground party. Message pickup methods and techniques are described in appendix XVII.

Section IV. MESSENGER AND COURIER SERVICE

22. General

Air messenger/courier service provides a means of communications either within the headquarters to which the messenger or courier is assigned or between adjacent units. It is used extensively in the transmission of messages and other material requiring physical distribution or delivery and is particularly useful for employment over large areas between widely separated points, or to locations where accessibility by surface transportation is difficult or impossible. This service can be made available to all units as conditions warrant.

23. Air Messengers

Messages may be given to an aviator, a passenger-messenger, or an observer prior to takeoff, or passed to an aircraft in flight by means of radio, pickup, panels, or other visual means (app. XVII). Messages may be delivered after landing, by the aviator, observer, or passenger-messenger, or from the aircraft in flight by radio or drop means.

24. Air Courier

Air courier service is an important mission of Army Aviation, and differs from airplane messenger service in that commissioned officers act as couriers. AR's 66-5 and 66-10 explain the normal administrative and operational procedures involved in courier service.

a. Air courier service provides a rapid and safe means of circulating administrative information and materials among higher echelons and subsidiaries throughout a widespread theater of operations. It relieves electrical signal communications of a large portion of nontactical, low-precedence traffic which is transmitted more efficiently by air courier. The use of commissioned officers as couriers

permits transmission of highly classified material in clear text. Commissioned officers are also used as couriers for cryptographic documents and equipment.

b. In echelons below theater level, air courier service is special rather than scheduled messenger service. The unit commander issues orders for the service and appoints the officer courier; the unit aviation officer provides the transportation. In many cases, the pilot of the aircraft serves as the officer courier. Couriers are responsible to the unit commander for safe delivery of air courier materials.

c. The procedure for air courier service operation varies in different echelons and must be designed to meet local requirements. The procedure discussed below serves as a guide in echelons below theater level.

- (1) Local instructions defining air courier material should be issued by the unit commander.
- (2) Material for transmission by air courier should be examined by the responsible section to insure that it is correctly addressed, that its origin is clearly indicated, and that it is acceptable for delivery by air courier means.
- (3) Messages should be sorted and listed in logical sequence of their destination, and should then be registered and prepared for dispatch.
- (4) A receipt for parcels and bags must be signed by the courier who assumes responsibility.
- (5) At the destination, a receipt for such parcels and bags must be obtained from the designated addressee or authorized agent to relieve the courier of responsibility.
- (6) In some situations, the air courier should submit a report to proper authority to give details of the trip and to point out any unusual occurrences.

25. Types of Air Courier Service

Courier operations are classified as scheduled or nonscheduled.

a. *Scheduled.* These include—

- (1) Delivery of periodic reports or overlays.
- (2) Delivery of distribution between message centers.

b. *Nonscheduled.* This includes delivery of captured personnel documents or equipment not on a scheduled basis.

26. Rotary Wing Aircraft

Appropriate rotary wing aircraft are utilized for messenger and courier service when road networks, traffic conditions, and lack of landing strips preclude service by other means. They are particularly desirable for messenger service in amphibious operations and for special operations in mountains, jungles, and other areas where

it is impracticable to obtain airstrips for other type liaison aircraft. Vertical ascent and descent, and other advantages, make this aircraft extremely useful in providing shore-to-ship messenger service in an amphibious operation. Rotary wing aircraft are particularly suited also for courier missions within the division sector; fixed wing aircraft may be effectively employed from division and higher headquarters. Rotary wing aircraft are utilized to fulfill scheduled courier commitments when the weather prevents these being accomplished by fixed wing aircraft.

27. Security

a. In using Army aircraft for messenger and courier service, care must be exercised that information transmitted by Army aircraft is not allowed to fall into the hands of the enemy if the aircraft is forced down. Generally, material of intelligence value should not be carried by Army aircraft scheduled to fly over enemy territory.

b. Pilots on messenger missions to units whose airfields may be under observation by the enemy must take every precaution to avoid revealing the location of the field. Pilots should be thoroughly familiar with landing and takeoff procedure of the airfield and, if necessary, should prearrange landing instructions with the aviation officer of the unit concerned.

Section V. WIRE LAYING

28. General

a. Army aircraft lay wire across untenable areas of the battlefield as well as over difficult terrain, such as gullies, streams, steep slopes, and marshy areas which present an obstacle to conventional means of wire laying. The type of wire dispenser used limits the length of wire which can be laid. In general, fixed wing aircraft can simultaneously lay two wire circuits, each approximately two miles in length, or a continuous line of approximately four miles.

b. At present, no method exists for cutting wire from a fixed wing aircraft in flight, since only an inversely wound coil can be used in wire laying. Unlike fixed wing aircraft, large rotary wing aircraft can use any type of spool or reel for laying wire. The superior maneuverability of rotary wing aircraft, particularly ability to hover, makes this type aircraft more suitable than a fixed wing aircraft for aerial wire laying missions. The distance to be laid on any flight is limited by the wire payload. Wire can be cut away from the rotary wing aircraft in flight when the required length has been laid. Disadvantages of the use of observation rotary wing aircraft include their slow speed, vulnerability in combat areas, and

their likelihood of drawing fire or other hostile action when above a critical combat area.

c. Use of Army aircraft for wire laying is justified only when the terrain or the tactical situation precludes conventional methods.

29. Equipment and Technique

Wire laying equipment and technique are discussed in appendix XVIII.

Section VI. RADIO RELAY

30. General

Radio relay is rapidly becoming a primary means of communication, providing installation timesaving capabilities. These capabilities, however, cannot be fully exploited because of the limitations of ground transportation. Army aircraft may be used to overcome the limitations inherent with ground transportation. They provide a means for terrain surveys for radio relay sites and for airborne radio relay operations during limited periods of time.

31. Establishment of Ground Radio Relay Stations

It is often desirable to install radio relay stations at points inaccessible to ground transportation such as swamps, deserts, arctic tundra, precipitous areas, or mountain peaks. Installation may require island-hopping or the traversing of inadequate or congested roads. Aircraft, especially rotary wing, can be used to transport personnel and equipment to selected sites enabling the installation of important circuits with maximum speed. After the initial installation, aircraft may be used to supply operating personnel with rations, POL, and maintenance parts.

32. Aircraft as Airborne Radio Relay Stations

Army aircraft may be used effectively as radio relay stations between ground troops and/or tactical aircraft supporting ground attacks; however, they are only employed for this purpose when ground relay stations are impracticable because of distance or time elements. When aircraft are used as radio relay stations for extended periods of time, the radio net in which the relay operates is changed frequently and, if possible, on a time schedule.

Note. Airborne radio relay aircraft utilizing automatic retransmission of signals require installation of special radio equipment.

Section VII. PROPAGANDA DISSEMINATION

33. General

Army Aviation support of special warfare activities includes aerial distribution of propaganda leaflets. Requests for propaganda or counterpropaganda leaflet drops are the responsibility of G3.

34. Drop Technique

Careful planning of propaganda leaflet drop missions assures maximum effective distribution of the leaflets. Factors to be considered in planning drop missions include—

- a. Communication routes within the area.
- b. Coordination of friendly fires.
- c. Wind direction.
- d. Optimum drop altitude.
- e. Number of leaflets and method to be dropped.
- f. Enemy air defense capabilities.

35. Execution

A practice run is made over friendly terrain and a few leaflets or pieces of papers are released to determine drift to apply on the actual drop. An effort is made to distribute all leaflets for a given area at the same time. Aviators apply the principles of defensive flight (par. 201) when enemy opposition is encountered during these operations.

Section VIII. AUDIO MEANS OF COMMUNICATION

36. General

Electronic equipment used in Army aircraft to perform a special mission is often not designed as avionic equipment. However, loudspeakers and sirens designed for ground vehicles may be modified, when necessary, for satisfactory operation in Army aircraft.

37. Uses

Both fixed and rotary wing aircraft are capable of transporting noise-producing equipment (loudspeakers, sirens, etc.) for support of the following activities:

- a. *Propaganda Dissemination.* Psychological warfare and civil affairs military government units may use Army aircraft as an airborne loudspeaker system to disseminate propaganda and information to frontline enemy troops and civil populations.
- b. *Warnings.* Immediate danger warnings (fallout, bacteriological warfare) may be disseminated to isolated, disorganized units and civil populations having no available communications.

c. Riot Control. Directives and ultimatums are most effectively disseminated to rioting groups through the use of loudspeakers.

38. Planning

Careful planning will insure better results in disseminating information. Factors to be considered are—

- a.* Wind direction.
- b.* Optimum altitude.
- c.* Density of personnel to receive the information.
- d.* Coordination of friendly fires.

39. Execution

For adequate coverage and clarity of information, fixed wing aircraft must continually orbit over the desired area at the safest low altitude possible. Rotary wing aircraft are generally not well suited for this type mission because the noise level of the aircraft renders the intended audible signal ineffective.

Section IX. TRAINING FOR AVIATION SUPPORT MISSIONS

40. General

Flexibility and versatility of Army Aviation prevent listing all of its possible missions. The commander must train the unit to perform primary assigned functions as well as any potential function which it might perform in combat. Training should emphasize safety, skill, and maximum effective utilization of equipment. Training for specific Army Aviation support missions will include—

- a.* Observation, reconnaissance, and survey.
- b.* Aerial resupply.
- c.* Command, liaison, and communications.
- d.* Aerial evacuations for medical treatment.
- e.* Airlift of personnel.
- f.* Air mobility for land reconnaissance.
- g.* Airlift of equipment and supplies by internal or external loads.

41. Communication Training

Effective aviation support operations require crew proficiency in radiotelephone procedure. Brevity of transmissions is essential to facilitate timely exchange of intelligence information. Aviators and observers must be trained in all authentication systems to be employed. Communications training is a command responsibility normally conducted by the aviation unit communications officer. Aviators, observers, and operations and communications personnel are trained to assist administrative and combat forces. Training emphasis is placed on proper and flexible use of aircraft communica-

tion equipment, defense against electronic warfare, communications security, and the use of alternate communications means during imposed radio silences.

42. Training for Aerial Control of Ground Movement

Training for aerial control of ground movement should include the following:

- a.* Establishing air-to-ground radio communications.
- b.* Assuring that tactical markings on vehicles are identifiable from appropriate flight altitudes.
- c.* Coordinating vehicular and CP marking requirements to assure their expeditious location.
- d.* Utilizing lights or other distinguishable markings for night air-to-ground control.

CHAPTER 5

AIRLIFT OF ARMY PERSONNEL AND EQUIPMENT

Section 1. AIRLIFT FOR TROOP MOVEMENT IN THE COMBAT ZONE

43. General

a. An important function of Army Aviation is to transport personnel and units within the Army combat zone during combat and logistical operations. This transportation includes the movement of units to execute unilateral air-landed operations, the movement of reserves, and the shifting and relocation of units and individuals within the combat zone.

b. The requirements for air transportation are generated by—

- (1) The need for attaining strategic or tactical advantage.
- (2) A requirement for speed and flexibility.
- (3) A possibility of saving material, personnel, or money by reducing to the minimum the requirements for surface transportation.
- (4) A reduction in the quantities of stocks in forward areas.
- (5) Inadequate surface routes of communication as a result of—
 - (a) Enemy interdiction or severance of surface routes of communication.
 - (b) Terrain obstacles or restrictions which seriously limit the use of surface transportation.
 - (c) The advance of friendly forces exceeding the capability of surface transportation.
 - (d) The isolation of friendly forces.

c. Basic considerations for the use of air transportation are as follows:

- (1) Availability of aircraft of suitable speed, range, and cargo capacity.
- (2) Facilities and terrain characteristics at rear airbases, intermediate landing points, and destinations.
- (3) Weather.
- (4) Light conditions.
- (5) Ability to maintain control of air routes of communication.

- (6) Availability of trained personnel to load, unload, and operate aircraft.
- (7) Availability, adequacy, and relative savings of time, men, and materiel through use of other means of transportation.
- (8) Adequacy of communications facilities.
- (9) Time available.
- (10) Enemy air defense capability.

44. Limited Troop Movement

Both fixed and rotary wing aircraft can be used for the movement of troops within the combat zone (fig. 2). The type of aircraft used is dependent on the situation and on evaluation of the known capabilities and limitations of the two types of aircraft. At the present time, the main advantage of fixed wing over rotary wing aircraft is that fixed wing aircraft have a greater range and speed than rotary wing aircraft and require less maintenance. However, the inherent characteristics and capabilities of rotary wing aircraft normally make it a better choice of vehicle for transporting troops over short distances within the combat zone. Some important rotary wing capabilities are:

a. Under normal conditions, rotary wing aircraft can operate from confined and unimproved areas.

b. While hovering, troops can be loaded or unloaded.

c. Rotary wing aircraft possess a wide speed range, from 0 to approximately 120 knots.

d. They can be landed in the objective area in tactical formation when suitable landing zones of sufficient size are available.

e. Rapid deceleration, combined with slow forward speed and near vertical landing, enables rotary wing aircraft to operate under marginal weather conditions and at very low altitudes.

f. Rotary wing aircraft provide a relatively stable platform on which to mount appropriate weapons to furnish suppressive fires when landing in enemy-held areas.

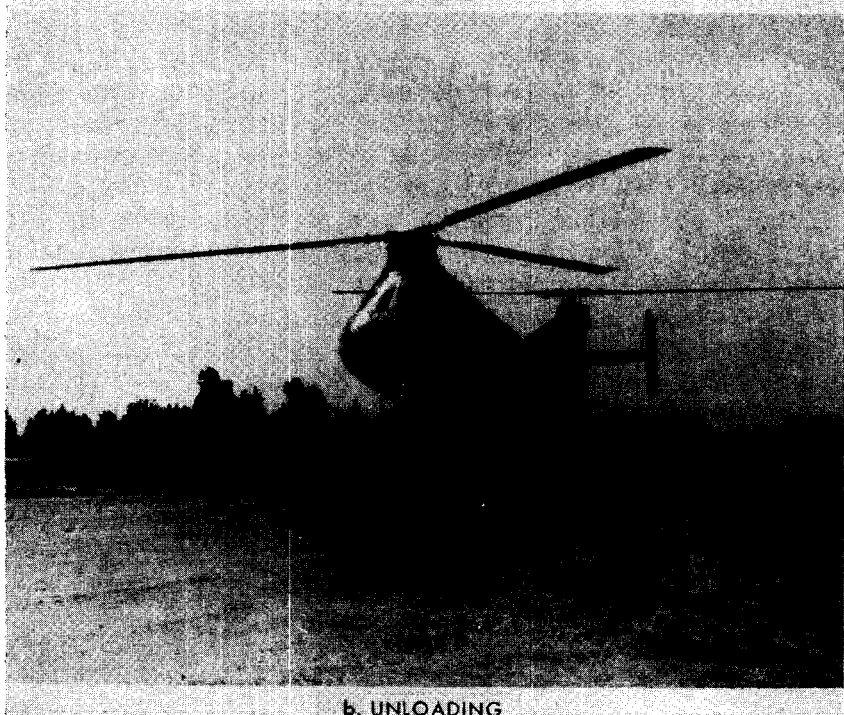
45. Unilateral Air-Landed Operations

a. Air-landed operations are conducted in mass with emphasis on mobility, surprise, and speed. Tactical surprise is achieved through aircraft delivery of assault forces directly upon or immediately adjacent to their objective. Aggressive ground attack exploits surprise by prompt seizure of initial objectives, and the rapidity of the attack reduces vulnerability to enemy counteraction. For a more complete coverage of air-landed operations, see FM 57-35.

b. Tactical planning and logistical considerations for an air-landed operation are many and varied, and increase proportionally with



a. LOADING



b. UNLOADING

Figure 2. Movement of troops in the combat zone.

the size of the transported force and the nature of the objective. An air-landed operation can be broken down into three broad phases:

- (1) The planning and preparation phase, which includes the planning of the operation, all prior preparations, and loading.
- (2) The air movement phase, which encompasses the approach flight, unloading, and return flight.
- (3) The assault phase, which includes landing and reorganization, seizure of initial objectives, and development and defense of the airhead.

c. Planning for an air-landed operation is more complex and more critical than a comparable ground tactical operation. Consequently, planning must be as detailed as time permits. All preparations must be completed to allow sufficient time for movement to the loading sites and loading of aircraft. Timing is critical in terms of changing weather conditions, security, and exploitation through surprise.

d. The commander of an air-landed force is responsible for conducting the air movement of his forces. He uses a movement control center, pathfinders, and the necessary personnel and equipment of the supporting aviation unit to help control the movement. The commander of the supporting aviation unit maintains liaison with the troop commander, advises and assists the commander of the air-landed force, maintains communication with the movement column, and transmits movement instructions. At prescribed times, as set forth in the air movement table, serials take off from the loading area by flight unit and follow specific flight routes which are defined by air control points (checkpoints). Upon reaching the release point (RP), the flight serials within the air column, or flight units within flight serials, leave the column and proceed to the assigned landing zones. To reduce congestion in the landing zones and minimize the time aircraft will be exposed to enemy fire while on the ground, they are unloaded rapidly and take off for return movement by flight units without organizing into flight serials.

Section II. TRAINING FOR AERIAL TROOP MOVEMENT

46. Phases of Training

Training for aerial troop movement is divided into three phases:

a. The first training phase includes individual training of aviators in aircraft operations involving internal and external loads, formation flying, low-level navigation, and confined area landings and takeoffs. Ground troops to be transported receive individual training in safety precautions to be followed in approaching aircraft, loading and lashing techniques, use of aircraft seat belts, and

the proper unloading or debarking technique. Ground unit SOP's for air mobile task force organizations and loading plans for these organizations are developed.

b. The second phase is a unit training phase. Ground troops are given orientation rides in aircraft operating out of large landing sites. Commanders and pathfinder personnel receive training in navigation and operation within the landing site. Staff officers coordinate the efforts and employment of progressively larger air-landed units. Aviators practice more advanced formation flights with emphasis on night capabilities.

c. The third phase is the advanced training phase. Larger and closer formations of aircraft move greater distances and occupy smaller landing sites. Aircraft land in tactical formation to facilitate rapid and accurate deployment of ground troops.

47. Control

Command and navigation control for the conduct of unilateral air-landed operations requires considerable staff and pilot proficiency. Training problems and exercises should be conducted over terrain of increasing topographic complexity similar to that used in the progressive training for aerial supply operations (par. 52).

Section III. RAPID MOVEMENT OF SUPPLIES IN THE COMBAT ZONE

48. General

An important function of Army Aviation is to expedite movement of critically needed combat supplies and/or equipment to supplement the ground transportation system operating within the field army. Major mission responsibility for this task is vested in transport aircraft units, which are organized and trained to provide the commander with increased mobility and flexibility. These units are capable of transporting supplies, equipment, and personnel on a continuous basis in support of tactical operations. Although Army transport aircraft units have the mission of performing the type missions as stated above, any Army Aviation unit is capable of limited resupply missions if its aircraft can carry the type supplies needed. The division aviation company furnishes an important means of delivering critical emergency supplies directly to the requesting unit.

49. Aerial Delivery Responsibilities

a. *Supplies.* The appropriate S3/S4 or G3/G4 will designate personnel to accomplish the following under the direct supervision of the pilot of the aircraft:

- (1) Rigging and packaging of supplies.
- (2) Loading and/or lashing supplies in the aircraft.
- (3) Ejection of supplies from the aircraft.

b. Equipment. Personnel from the unit being supported, under the direct supervision of the pilot of the aircraft, will be responsible for accomplishing the requirements covered in *a*(1)–(3) above, in the event that the equipment to be delivered is organic to the supported unit.

c. Establishment of the Drop Zone T. The supported unit is responsible for the establishment of the drop zone T.

50. Types of Supplies

Any item can be air delivered if weight and size will permit its transportation by Army aircraft. Common items include food, water, ammunition, medical supplies, and communication equipment. Aircraft weight and balance requirements must be met to assure safe operation. Most aviation units have a weight and balance file for all common-type loads. This practice is recommended since it tends to speed up the process of delivering needed supplies to combat troops. For details on daily supply requirements of various units in combat, see FM 101–10.

51. Methods of Delivery

There are three methods of delivering supplies and equipment by air: air landed, parachute, and free fall. Factors influencing the selection of the method to be used include the tactical situation, weather, terrain conditions, type of supplies or equipment, availability of airstrips or landing and drop zones, light conditions, and type of aircraft and other equipment available. Resupply equipment and technique of aerial delivery are given in appendix XVI.

a. Air Landing. Air landing is the preferred method of delivery, since cargo is delivered with the least loss and breakage and requires a minimum of handling both in preparation for delivery and in recovery. It also makes the most efficient use of available aircraft. This method should be used whenever possible by fixed or rotary wing aircraft. Air landing includes rotary wing external delivery. For details see appendix XIX.

b. Parachute Delivery.

- (1) Parachute delivery, although less efficient than air landing, is a highly flexible method of delivering cargo. Dropping supplies in containers by parachute is the method best suited for supplying small, separated units when inadequate landing facilities or the tactical situation precludes air-landed delivery.

- (2) Some of the limitations of parachute delivery are:
 - (a) Aircraft carry smaller useful payloads when used for parachute supply operations.
 - (b) There is the possibility of losing part of the supplies in inaccessible areas.
- (3) The minimum altitude for dropping cargo parachutes is approximately 150 feet. This is low enough to provide reasonable accuracy in dropping into the desired area, yet high enough to permit opening of the parachute in time to break the fall.

c. Free Fall.

- (1) Free fall is the least desirable method of delivering cargo, but may be resorted to when transport aircraft cannot land, when facilities are not available for delivery of supplies by parachute, or when such delivery is not practicable. It is only advisable for delivery of nonfragile objects such as clothing, blankets, and tentage.
- (2) The big disadvantage of the free fall method is the loss that must be expected due to the extreme damage to containers and supplies caused by the forward momentum. This disadvantage is lessened considerably by the use of padding, and drops from aircraft flying at minimum air-speed. Rotary wing aircraft have the advantage of dropping supplies without forward momentum.
- (3) Free fall deliveries are made from lowest safe altitude (about 50 feet).

Section IV. TRAINING FOR AERIAL MOVEMENT OF SUPPLIES

52. General

Training in aerial movement of supplies is conducted to give individual aviators proficiency in the use of aircraft as cargo vehicles. To facilitate night training in the conduct of these missions, aviators should be briefed on the terrain at the loading point, the unloading point, and the intervening area. Unit training should include logistical support exercises for ground operations conducted in progressively more difficult topography and requiring increased navigational skills. Ground supply handlers should be familiar with standard hand and arm signals (app. XIV), aircraft landing and loading characteristics, and capabilities of type aircraft to be employed by the unit. Personnel working beneath cargo helicopters while attaching cargo slings should wear eye protective goggles and headgear. Only experienced personnel should be allowed at the loading and landing sites during operations. Colored or numbered

markings for aircraft, cargo, and loading and unloading zones are recommended.

53. Aerial Resupply Equipment

a. Aircraft. When establishing maximum lift capabilities for aircraft, such factors as wind, temperature, barometric pressure or flight altitude, aviator proficiency, and individual aircraft performance must be considered. The aviation unit trains personnel to determine maximum lift capabilities of aircraft under any given set of conditions.

b. Aerial Delivery Equipment. All flight and supported personnel must be trained in the proper recovery and disposition of aerial resupply equipment. Present available aerial delivery containers suitable for use by Army aircraft are explained in appendix XVI.

CHAPTER 6

AIR MOBILITY FOR LAND RECONNAISSANCE

Section I. AERIAL COMBAT RECONNAISSANCE

54. General

Aerial combat reconnaissance is conducted by units equipped with armed aerial vehicles utilized for reconnaissance, troop transport, and fire support. Such units organized for this purpose provide rapid reconnaissance and intelligence collection, increased mobility over ground forces, immediately available firepower, air mobile infantry, flexibility, rapid response to commands, and shock action. A unit organized for aerial combat reconnaissance has a greater chance for survival in the battle area and is virtually independent of terrain obstructions that restrict surface movement of maneuvering forces.

55. Mission

This unit is capable of the following missions:

- a.* Providing armed aerial reconnaissance over remote areas.
- b.* Providing rear area security against airborne or guerilla forces.
- c.* Covering forces for advance, flank, or rear guard action.
- d.* Countering enemy action in exploitation of mass destruction weapons.
- e.* Engaging and destroying enemy forces by use of mobile fire and maneuver tactics.
- f.* Providing armed aerial reconnaissance between dispersed battle area strongpoints or islands of resistance.
- g.* Providing mobile counterreconnaissance striking forces.

56. Concepts of Employment

The basic concepts of employment for units organized for aerial combat reconnaissance are—

- a.* Using mobility and agility to achieve tactical surprise and reduce vulnerability.
- b.* Striking the enemy at his weakest point.
- c.* Operating at minimum altitude, utilizing natural terrain features for cover, concealment, and hidden avenues of approach.

d. Using firepower in conjunction with maneuver to assist assault elements in closing with the enemy.

57. Battle Drills

Battle drills, extremely valuable in the training of aerial combat reconnaissance units, should be conducted in accordance with the announcement of the overall pattern of action. This is necessary to preclude stereotyped maneuvers restricting the commander's use of these units. Variables (such as last-minute changes in enemy strength, dispositions, and capabilities) should be included, with exercises conducted over varying types of terrain.

Section II. AIR DELIVERED RECONNAISSANCE ELEMENTS

58. General

a. The infantry, airborne, and armored divisions have the capability for transporting reconnaissance elements into enemy territory by Army aircraft. These elements may consist of one or two individual observers or a complete reconnaissance patrol. They may be classified as air transported reconnaissance patrols, parachute delivered reconnaissance patrols, and airdropped observers. Air transported reconnaissance elements are characterized by increased mobility, rapid commitment over long distances, rapid withdrawal, and flexibility of action.

b. The mission of air transported reconnaissance elements is to extend the capability of other information collecting agencies. Air transported reconnaissance elements are capable of performing the following type missions:

- (1) Air/artillery target selection.
- (2) Observation and control of air/artillery strikes.
- (3) Damage assessment.
- (4) Radiological and bacteriological survey.
- (5) Route and area reconnaissance.
- (6) Location and identification of units and/or installations.
- (7) Engineer reconnaissance.
- (8) Surveillance.

59. Organization

Air transported reconnaissance elements are organized and equipped the same as land transported reconnaissance elements. They are trained in the techniques of land reconnaissance and the techniques of loading and unloading from Army aircraft. If they are to be airdropped, they are trained in the techniques of parachuting.

60. Command

The patrol leader is the commander of the air transported reconnaissance elements. He is responsible for the execution phase of the air transported reconnaissance mission after reaching the landing (drop) zone. During loading, flight, and landing, the aircraft commander (flight leader) is in command of the aircraft and passengers. During flight, the patrol leader is kept informed of the aircraft's progress by the aircraft commander. If a change of flight route or landing site is required, the aircraft commander notifies the patrol leader of the change. If an unplanned situation arises, the aircraft commander should consult the patrol leader for instructions.

61. Responsibilities

The decision to employ air transported reconnaissance elements is usually made at battle group or higher level. The intelligence officer (S2, G2) has staff responsibility for planning the details of the reconnaissance mission and supervising rehearsals. He is assisted by the patrol leader, the aircraft commander, and other staff officers as required. He briefs and debriefs the patrol leader and aircraft commander.

62. Aircraft

a. The type aircraft employed will depend upon the mission, the enemy situation, the distance to be traversed, and availability of aircraft. When the aircraft is to remain in an enemy-controlled area, the local security of the landing site is the responsibility of the aircraft commander. Ground personnel, selected prior to the mission, are added to the aircraft crew to furnish local security and to assist in camouflaging the aircraft. Additional equipment (camouflage nets, prepared camouflage material, axes, shovels, antipersonnel mines, grenades, trip flares, sound powered telephones, etc.) is carried as required.

b. Rotary wing aircraft may employ suppressive fire against targets jeopardizing the mission.

63. Planning

a. The dispatch of reconnaissance patrols by air into enemy-controlled areas depends also upon these considerations:

- (1) Use of air as the best means available.
- (2) Capability to accomplish the mission.
- (3) Availability of individuals skilled in reconnaissance techniques.
- (4) Sufficiency of information of the enemy to allow selection of desirable flight routes and landing sites.

- (5) Availability of cover and concealment for the aircraft from enemy ground observation and fire.
- (6) Friendly command of the air where the patrol will be operating.
- (7) Weather conditions favorable for flights in and out of enemy-controlled areas, and for communication by the patrol with its directing headquarters.
- (8) Fire support to assist the flights over enemy-controlled areas and to aid the patrol in its withdrawal.

b. Preparation of the mission plan begins as soon as possible, with the patrol leader and the aircraft commander giving assistance in coordination of the ground reconnaissance plan and the landing and flight plans. The intelligence officer coordinates planning with other principal staff officers. The ground reconnaissance plan is considered first and all other planning is based upon it. Consideration is given to—

- (1) Objectives.
- (2) Covered and concealed routes of approach and exit.
- (3) The landing plan to include delivery, landing, and parking sites (if required) in the enemy-controlled area plus alternate sites.
- (4) Approach and return flight routes.
- (5) The fire support plan to include—
 - (a) Fire plans designed to weaken or demolish known and suspected enemy weapons capable of firing on the patrol during the flight and to deny enemy observation of the flight.
 - (b) Use of smoke placed on known and suspected enemy observation posts and weapons to deny observation and to interrupt fire.
 - (c) Appropriate fires to assist the aircraft during withdrawal from the objective area.
 - (d) Fire support agencies (e.g., forward observer, air control team, etc.) in the patrol.
 - (e) Plans for destruction of enemy air defense artillery.
- (6) Diversion of enemy fire. The patrol's flight through the enemy forward area may be timed to coincide with actions that will cause him to disperse his fire and divert his attention. These actions include—
 - (a) Presence of other aircraft in the area, such as close air support, drone aircraft, and observation aircraft.
 - (b) Action by friendly ground troops such as ground attacks, demonstrations, or feints.
- (7) The use of pathfinders or terminal guidance.
- (8) The debarkation plan.

- (9) The rendezvous plan.
- (10) The withdrawal plan.
- (11) The camouflage plan.
- (12) Local security at the parking site, if required.
- (13) The communication plan.

64. Reconnaissance

A reconnaissance is made of the objective area and the routes to it. It should be made jointly by the patrol leader and the aircraft commander, by aerial flight, by study of tactical maps and aerial photomaps, and by all other available means. Advantages of this reconnaissance are that it allows—

- a.* Selection of the best flight routes and landing sites.
- b.* Determination of the best covered and concealed ground routes of approach to and withdrawal from the objective.
- c.* Aviator and patrol leader to become familiar with the flight route, landing sites, and the terrain in the objective area.
- d.* The aviator to make landings at night with little or no hovering or terminal guidance.
- e.* Selection of material for concealing the aircraft should the aircraft have to be retained in the enemy-controlled area.

65. Coordination

The intelligence officer coordinates the reconnaissance plan with higher, adjacent, lower, and supporting units and with other units, especially air defense artillery, over whose area the patrol will pass.

66. Aircraft Disposition Upon Delivery of the Patrol

The commander directing the mission orders proper disposition of the aircraft after their delivery of the patrol. The aircraft may be withdrawn to friendly lines and returned later to pick up the patrol or parked in the enemy-controlled area. The commander may use ground movement rather than air for withdrawal of the patrol.

67. Navigation

Aircraft are flown as close to the ground as safety will permit. Low-level flight is advantageous to the patrol because of decreased enemy ability to observe or detect aircraft at appreciable distance. Pilots and copilots must be proficient in low-level navigation and rapid interpretation of tactical maps.

68. Penetrating Enemy Defensive Area by Air

Penetration of the enemy defensive area by air is accomplished through a combination of prepared fire support, and skillful use of the techniques given below.

a. Flight Routes.

- (1) Make maximum use of low-level flight.
- (2) Offer maximum cover and concealment from enemy ground observation and fire.
- (3) Facilitate coordination and use of the best fire support and dispersion plans.
- (4) Be beyond the range of, and downwind from, known and suspected conventional enemy weapons positions and ground observers.
- (5) Make use of terrain features that facilitate low-level flight.
- (6) Facilitate flight termination without circling.

b. Time of Flight.

- (1) Operation during periods of limited visibility reduce the enemy's range of observation and effectiveness of his observed fires.
- (2) Operation during periods of unlimited visibility requires greater emphasis on techniques to reduce enemy observation and detection.

c. Flight Formation. The "trail" formation with minimum distance between aircraft is advantageous in penetration of enemy areas in the minimum time and simplifying plans for suppression and dispersal of enemy fires. Infiltration by single aircraft may be effective through gaps between enemy units when patrols are to be landed over a wide area.

d. Close Air Support. Air Force aircraft may be used to—

- (1) Bomb, napalm, smoke, and machinegun enemy weapons.
- (2) Destroy enemy fighter or observation aircraft.
- (3) Warn the in-flight patrol of enemy air approach or of newly discovered enemy positions along the flight route or at the landing site.
- (4) Assist the patrol in landing by last-minute check of the landing sites.

e. Evasive Tactics. Evasive flight tactics are designed to prevent accurate visual sighting by enemy gunners. Such tactics are accomplished by periodically varying altitude and direction of flight during aircraft exposure to enemy ground fire.

f. Deceptive Flight Tactics. Rotary wing aircraft flying over enemy areas should employ deceptive measures to—

- (1) Conceal the intent of the flight.
- (2) Conceal the landing sites to be used.
- (3) Force the enemy to commit his counterreconnaissance patrols prematurely in areas other than those used by friendly patrols or those to be traversed by the patrol.

g. Deceptive Flight Techniques. Examples of deceptive techniques that can be utilized are—

- (1) Using at low-level flight.
- (2) Landing and debarking patrol at one location and parking the aircraft at another location.
- (3) Making one or more false landings while en route to the planned landing site.
- (4) Flying decoy aircraft in the vicinity of the objective area.
- (5) Using two rotary wing aircraft to land one. For example, one aircraft lands and cuts its engine; at this instant another aircraft flies low over the landed aircraft and diverts any enemy ground patrols in close proximity to it.
- (6) Conducting landings from straight approaches.

69. Landing Sites

a. General. Landing sites are selected to allow the aviator to deliver the patrol either by landing or while hovering. Alternate sites are selected in event the original sites are discovered. Landing sites should—

- (1) Contain an air approach offering cover and concealment from enemy ground observation and fire.
- (2) Be located at sufficient distance from enemy installations so as not to prematurely alert the enemy.
- (3) Be adjacent to a covered and concealed ground route of approach to or from the objective.
- (4) Be easy to locate during daylight and darkness.

b. Parking Site. A parking site may function as a delivery or pickup site and as such should have the site characteristics described in *a* above. For a parking site the following additional characteristics are desirable:

- (1) Limited number of ground routes of accessibility so that the aircraft crew can establish effective local security.
- (2) Ready concealment of aircraft from enemy observation, air and ground.
- (3) Location on terrain not trafficable to enemy motor patrols, thereby requiring the enemy to search for the aircraft on foot.
- (4) Routes of accessibility permitting ambushes of small enemy patrols. (Also, enemy patrols must proceed with caution in such areas.)
- (5) Maximum cover and concealment from enemy ground observation and fire.

c. Organization of the Parking Site. The parking site is organized to prevent enemy destruction of the aircraft. Preparation of the site includes—

- (1) Along avenues of approach, setting up ambushes, laying antipersonnel minefields, and setting out warning devices such as trip flares.
- (2) Camouflaging aircraft.
- (3) Organizing a communication network to give warning of enemy approach. (Use of sound powered telephones should be considered.)

d. Aircraft Camouflage at the Parking Site. Camouflaging consideration is given to possible aircraft discovery by aerial and/or ground observers. Camouflage preparations (painting of aircraft, procuring camouflage nets, rehearsing camouflage plan, etc.) are made prior to the mission. Camouflage is facilitated by locating the landing site close to a tree line. All camouflage material must be easily removable to permit prompt takeoff.

70. Withdrawal of the Patrol

a. Effecting the Rendezvous. When effecting withdrawal rendezvous the patrol leader should—

- (1) Secure the rendezvous site.
- (2) Describe the ground situation to the pilot by radio, or by a light or color device.
- (3) Direct the landing of the aircraft.
- (4) Supervise the loading of the aircraft.
- (5) Give command for departure.

b. Overland Withdrawal. The patrol is prepared for withdrawal overland if withdrawal cannot be effected by air.

71. Conduct of the Ground Mission

Air transported reconnaissance elements landed in the objective area accomplish their mission as described in FM 21-75.

72. Communications

a. Patrol and Aircraft Radio Net. The aircraft should be equipped with a radio which will net with the patrol's radio.

b. Communication Security. To prevent premature discovery by electronic devices, use of the patrol's radio equipment in the objective area is held to a minimum. The following procedures are followed:

- (1) Transmit required information only.
- (2) Transmit at a predetermined time.
- (3) Use a preplanned code to reduce transmitting time to a minimum.
- (4) Keep home radio on listening watch.

Section III. TRAINING FOR AIR DELIVERY OF RECONNAISSANCE ELEMENTS

73. Training of Aviation Units

a. The utility flight of the division aviation company is trained to provide air transport for all types of land reconnaissance forces within its capability. Other elements of the company may be trained to transport intelligence specialists or other personnel behind enemy lines.

b. During training, airmobile task force organizations should be habitually made up of the same units. This achieves continuity in training and provides the ground elements with a thorough knowledge of aerial operations.

74. Preliminary Training of Ground Personnel

Preliminary training of ground personnel for air delivered reconnaissance missions is the same as for any air transported move. It should include the following:

a. Orientation in the capabilities and limitations of the aircraft to be utilized.

b. Loading, unloading, and in-flight procedures.

c. Familiarization with the aerial weapons system to be used, to include operation and maintenance.

d. Aircraft camouflage techniques under varied conditions.

75. Training of Aviation Personnel

Aviation personnel who participate in this type mission are trained in all aspects of the following:

a. Low-level navigation techniques.

b. Aircraft camouflage techniques under varied conditions.

c. Small unit defensive tactics.

d. Reading of maps and aerial photos, to include those of the enemy.

e. Potential guerilla contacts, including rudimentary language necessities.

f. Aerial weapons systems to be used, to include operation and maintenance.

g. Any other specialized knowledge appropriate to the particular mission being planned.

CHAPTER 7

OBSERVATION, RECONNAISSANCE, AND SURVEY

Section I. AERIAL OBSERVATION

76. Tactical Application

Observational data obtained by means of Army Aviation bridge the gap between detailed, close-in ground observation and long-range Air Force observation, and supplement ground data obtained by electronic observation services. Thus the commander is given a superior view of his operational area through observational detail that faster aircraft cannot obtain.

77. Aerial Observation Capabilities

Observation capabilities of Army aircraft include surveillance, target acquisition, conduct of fire, reconnaissance, camouflage inspection, survey operations, and location of friendly units. These capabilities are generally satisfactory for normal observation requirements of a division, and for adjustment of divisional organic and attached artillery fires. However, medium observation aircraft or high-performance aircraft of supporting services may be required for adjustment of fire, target evaluation, and damage assessment of long-range weapons.

78. Use in Contaminated Areas

Army aircraft equipped with the necessary instruments give the commander an expeditious means of locating and determining area size and intensity of chemical or radiological contamination (pars. 134, 135). Army aircraft may also be used to patrol these areas and to assist in ground movements in or around danger zones.

79. Preflight Planning

a. Unit Aviation Officer. The unit aviation officer is a special staff member whose thorough knowledge of the tactical situation and of the commander's decisions aids in advanced planning for observation missions. Planning is coordinated with S2 (G2), S3 (G3), and the supporting artillery. The aviation officer, assisted by his operations officer, adjusts his plan for aerial observation into the overall obser-

vation plan of the unit. Adequacy of aviator and observer briefings on each mission is insured by covering the following:

- (1) Tactical situation.
- (2) The weather situation.
- (3) General plan of observation and the aerial observation plan.
- (4) Specific mission to be performed, including areas, activities, and relative priorities.
- (5) Method and time of reporting.
- (6) Signal communication instructions, including radiofrequencies, call signs, codes, and restrictions (if any).
- (7) Special security regulations, including limitations on flight paths, altitudes, crossing of frontlines, and use of maps, documents, or codes.
- (8) Flying safety precautions, including known enemy air activity, enemy and friendly ground air defense artillery installations, anticipated friendly fire of proximity fuzed or atomic projectiles, and, if appropriate, special survival and evasion and escape procedures in case of forced landing.
- (9) Unit evasion and escape plan, to include rendezvous points for air rescue.

b. Aviator and Observer. After the briefing, aviator and observer jointly plan mission details, to include—

- (1) Evaluation of terrain to be covered, based on a study of maps and photographs or on familiarity with the area. Evaluation may be brief or detailed depending upon time available and the nature of the mission.
- (2) Map or chart preparation for convenient use during flight.
- (3) Preparation of detailed flight plan, covering time, flight path, routes, altitude, and other data.
- (4) Preparation of checklist to include all items covered in the mission briefing.
- (5) Check of aircraft, equipment, and supplies for the mission (maps, codes, fieldglasses, radio, camera, film, etc.).

80. Essentials of Aerial Observation

The aviator-observer team is trained (sec. II below) to recognize evidence of enemy activity, to adjust flight path and altitude to mission requirements, to make wise use of natural means to conceal mission purposes and aircraft, to record observed data for proper use, and to report information accurately.

a. Indications of Enemy Activity. Indications of enemy activity detected either in a general search or in a detailed study of an area are—

- (1) *Dust.* Dust may indicate movement of vehicles or troops, or the firing of artillery, tanks, or rockets.

- (2) *Smoke*. Smoke may indicate bivouac areas, messing areas, or weapons firing.
- (3) *Fire*. Fires indicate possible assembly area, bivouac area, or supply or ammunition dump.
- (4) *Light*. Lights indicate possible positions, bivouac, or night movement.
- (5) *Reflection*. Reflection may be from vehicle windshields, unpainted surfaces of weapons, or messing equipment in bivouac area.
- (6) *Flashes*. Flashes indicate possible artillery, mortar, tank, or rocket positions.
- (7) *Shadows*. Shadows aid in identification of objects in daylight. On roadways at night, shadows may reveal movement of troops and supplies.
- (8) *Incongruous objects*. Objects incompatible with terrain or background may indicate an installation or activity.
- (9) *Movement*. Movement may indicate any type of activity, either civil or military, depending upon direction and size or moving elements.
- (10) *Tracks*. Tracks aid in locating vehicles, assembly areas, gun positions, and bivouacs.
- (11) *Soil*. Freshly dug soil may indicate trenches, revetment, etc.
- (12) *Other*. Unusual shapes, sizes, shades, shadows, tones, or colors may indicate faulty camouflage.

b. Common Errors in Observation.

- (1) Staring at one point or small area reduces the scope of vision, and causes eyestrain.
- (2) Searching obvious places for activity, such as roads and ridge lines, detracts from ability to see activity elsewhere.
- (3) Failure to identify the activity with a recognizable terrain feature makes relocation difficult for later scrutiny.

81. Flight Paths

The flight path in the immediate vicinity of the airfield is controlled by instructions from the unit aviation officer. Instructions are based on considerations of terrain, weather, and protection of the airfield from exposure to enemy observation (pars. 79a(6) and 324). If no flight path has been prescribed, the observing team selects that one which will accomplish the observing mission with the least risk. Normally, this flight path is a compromise between the comparative safety of flying well behind friendly frontlines, the best observing position (directly over the observed area), and the possibility of disclosing the mission by flying too close to the area.

82. Altitudes

The proper altitude for observation depends upon the mission, the terrain, the weather, and the enemy's ability to interfere with the mission. Detailed examination of an area of activity may require the aircraft to fly at very low altitudes; more general observation may be accomplished effectively from considerably higher altitudes.

83. Direction of Observation

Identification of specific objects or activities is simplified when observed from several lines of view. In general, the observer should try to keep the sun at his back since objects are easier to identify in this manner and less tiring than observing toward the sun. In addition, aircraft detection is more difficult when enemy ground observers must look into the sun.

84. Use of Fieldglasses

Constant use of fieldglasses causes eyestrain, tends to canalize the observer's attention, and may cause him to neglect large sections of the area under observation. Fieldglasses should be used only for detailed study of specific objects or activities.

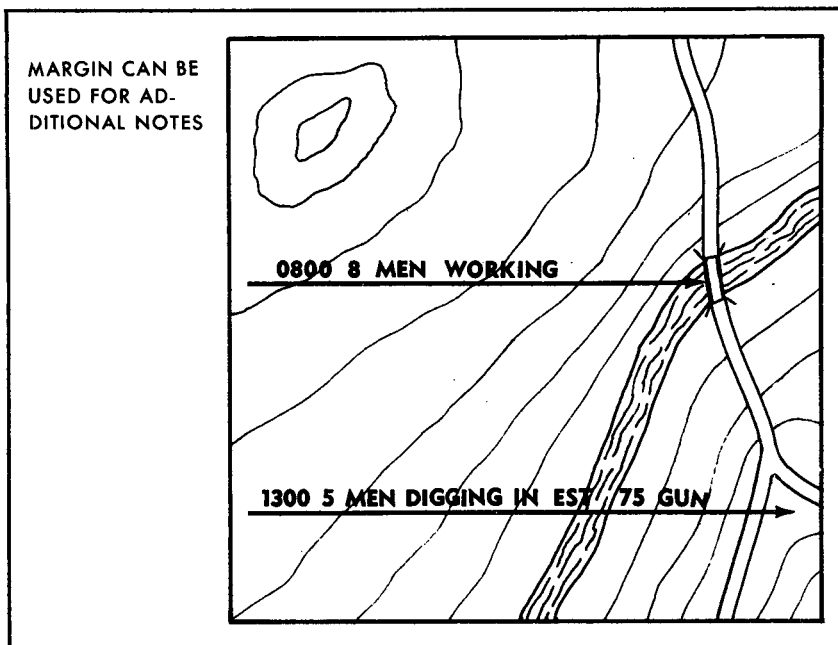
85. Recording Information

Prior to takeoff, the observer should fold his map to convenient size and arrange it in a map case (or other transparent substitute) to permit rapid recording of information obtained during the mission. When a clue to activity on the ground is detected, its location is marked on the map. After a more detailed examination discloses the nature of the activity, it is recorded by some convenient method, e.g., the ray method (fig. 3a) or the margin method (fig. 3b). Recorded information should be brief, but should indicate the time of the observation, what was seen, where it was seen, and the nature of the activity (fig. 3a).

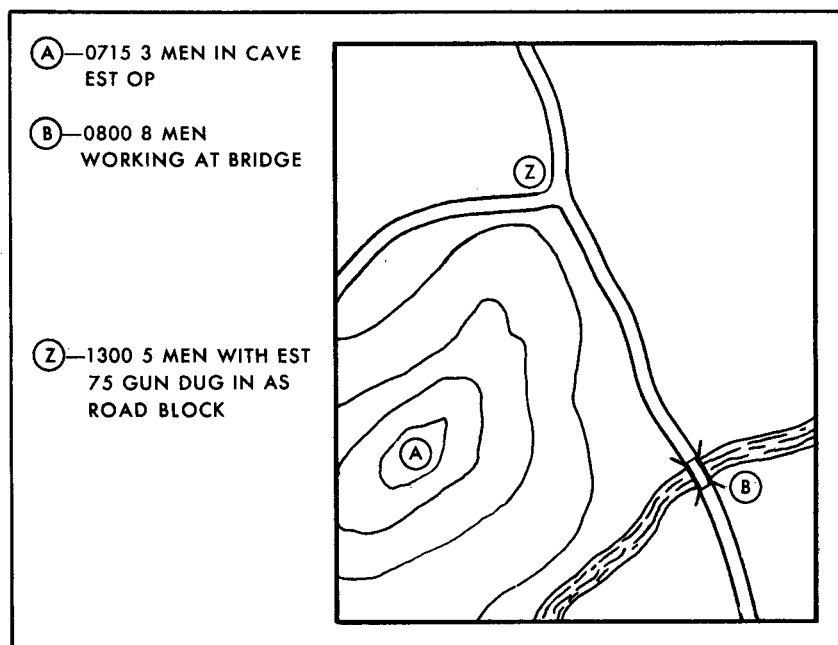
86. Reporting Information

a. Time and Method. Information may be reported immediately, at stated intervals, or upon conclusion of the mission, depending upon the nature of the mission and the unit aviation officer's instructions (par. 79a(4)). Information may be transmitted by radio; by dropping marked maps, overlays, or written messages; by oral report; or by any combination of these. Regardless of the reporting technique employed during the mission, the observer reports to the intelligence representative, aviation officer, or debriefing officer for oral interrogation upon completion of the mission.

b. Positive Information. When reporting his observations, the observer states as fact only what he has actually seen. When it is



a. THE RAY METHOD



b. THE MARGIN METHOD

Figure 3. Recording information on maps.

necessary to estimate such factors as distance or the size of troop units, he should state clearly that the information is an estimate. For example, tanks may be identified, but if their number is unknown, the observer might report, "Enemy tanks at (coordinates); estimated strength, one company."

c. *Negative Information.* Negative observation must not be ignored for it often provides highly valuable information to intelligence agencies, especially when it confirms other information. The observer should report negative information when requested or when considered pertinent. Again, as in the case of positive observation, care must be taken to limit a negative report to the mere fact that nothing has been seen. Failure to observe enemy activity must not lead the observer to assume or to report that no activity exists.

Section II. OBSERVER TRAINING

87. Aerial Observers

The ability to locate and identify the wide variety of objects and activities encountered in observation is of prime importance and can be developed only by extensive and thorough aerial observer training. Aerial observers may be classified as (1) trained observers and (2) temporary observers—each requiring specific types of training. Trained observers are graduates of a formal aerial observer training program, and aerial observation is their primary job in combat. They are usually members of the supported ground unit and are attached to the aviation unit for duty. Temporary observers provide a reserve for specific observation missions.

88. Aerial Observer Training Minimums

Aerial observer training minimums are contained in AR 95-51.

89. Training Techniques for Aerial Observation Missions

Aviators and aerial observers are trained to search terrain for the enemy, his dispositions, movements, and numbers; to read aerial photos; and to record and transmit information data accurately and promptly. Such observational training is accomplished under varied conditions of natural lighting and includes the proper use of vision aids such as sunglasses and binoculars. Prior to aerial artillery adjustment, range estimation from several altitudes is taught. Training includes instruction in search for camouflaged targets, and flight patterns and techniques most effective for each type observation mission. Physiological and psychological factors which influence observation and the use of aviation equipment are explained. Aerial observers may also receive limited training from qualified instructor pilots in the proper handling of flight controls in case of emergency.

90. Training for Aerial Adjustment of Supporting Weapons Fire

a. Nonnuclear Artillery. Aviators and observers are trained in the proper technique of aerial adjustment of supporting fires. This training is only slightly different from that taught ground observers in adjustment of these fires. In converting qualified forward observers to aerial observers range estimation and establishment of the gun-target line are given special emphasis. Early training in the use of all aircraft radios will prevent inadvertent transmissions on VHF or UHF equipment. Aviators and observers are trained to execute air relief of fire missions to permit uninterrupted fire on the target when one aircraft must be relieved on station.

b. Coordination With Friendly Airstrikes. Aviators of the aviation unit and attached aerial observers should receive training in the coordination and mutual support afforded by friendly airstrikes to include—

- (1) Assuring that targets and friendly troops are properly identifiable (by panels, colored smoke, etc.) prior to arrival of aircraft making the strikes.
- (2) Aerial positioning of forward air-control personnel to best coordinate the attacking strikes.
- (3) Vacating the airspace to be used by these faster aircraft.
- (4) Practicing early determination of the flight paths of such aircraft for the purpose of preventing midair collision.
- (5) Coordinating rescue efforts for downed pilots.
- (6) Reporting target misses when directed as part of the coordination mission, and reporting target damage assessment. (Target misses are reported in cardinal compass directions and distance yardage from the target; damage assessment, in percent of total destruction.)

c. Nuclear Fires. Physical and political effects of employing nuclear weapons (sec. V, ch. 10) are of such magnitude that observers acquiring nuclear targets must possess certain skills and qualities which are not necessary in observing for conventional weapons. The observer must be highly experienced and qualified militarily. He must be trained to properly analyze targets and correlate his analysis with weapons delivery systems available and the possible effects of the weapon on friendly as well as enemy personnel and operations.

91. Reconnaissance Flight Training

Time limitations imposed on aerial reconnaissance flights require aviators and observers of the aviation unit to be well trained in all types of reconnaissance flights. This flight training is conducted

at altitudes lower than those for surveillance training. Rapid visual identification of targets and objects is mandatory since return flights over the objective area are often prolonged and frequently dangerous.

a. Area Reconnaissance Training. This training qualifies the observer to report ground troops of company size or mechanized units of platoon size.

b. Route Reconnaissance Training. This training qualifies the aviator and observer to report the condition of communication lines, presence of roadblock, defiles, and bridges along the route observed.

c. Zone Reconnaissance Training. This training qualifies the observer for broader area coverage and wider flank coverage along the axis of advance.

d. Position Reconnaissance Training. This training qualifies the aviator and observer to select suitable positions for occupying units and their equipment.

e. Target Acquisition. See paragraph 117.

f. Aerial Radiological Surveys. See paragraphs 134 and 135.

92. Aerial Photo Training

The observer is trained (FM 11-40) in the following:

a. Operating photographic equipment.

b. Computing scale, altitude, and intervals.

c. Determining film requirements.

d. Taking photographs and keeping a current aerial photographic log. See appendix V for formulas, charts, and reference data.

Section III. AERIAL RECONNAISSANCE

93. Principles of Aerial Reconnaissance

a. Reconnaissance covers a specified zone and has a specific primary and secondary mission to accomplish within that zone.

b. Maps carried in aircraft are subject to capture and should not contain information of value to the enemy.

c. Personnel must have specific instructions regarding communication. Positive or negative reports should be rendered at prearranged times (par. 86).

d. Observing personnel should note all significant terrain and installations not included in the specified mission; thus they can report on conditions, facilities, and other data of value to the unit.

94. Advantages of Aerial Reconnaissance

a. Air reconnaissance is fast. The aviator-observer team can reach an area under consideration in appreciably less time than a ground reconnaissance party. It is possible to reconnoiter a long route or

a position from a greater distance than would be possible for a ground party.

b. Air reconnaissance is not roadbound. Aircraft can reconnoiter areas such as mountainous country and swampland, and can bypass roadblocks, rivers, and strong points to reconnoiter areas inaccessible to ground reconnaissance parties.

c. Greater coverage is possible. When the extent of reconnaissance prevents thorough ground coverage, aerial reconnaissance can adequately cover a greater area than a ground party in the same time. For example, a whole battalion position area to include all subordinate units can be reconnoitered from the air in a minimum amount of time.

95. Limitations of Aerial Reconnaissance

a. *Reliability.* It is difficult to obtain reliable aerial reconnaissance information under certain conditions. The following limitations must be considered when employing aircraft for reconnaissance missions:

- (1) Strength data of bridges is only an estimate and must be confirmed by ground reconnaissance or aerial photography.
- (2) Mines and boobytraps cannot be seen from the air.
- (3) Terrain surface may be misinterpreted from the air.
- (4) The load-carrying capacity of an unpaved road or a proposed cross-country route cannot always be definitely established from the air. Confirmation by ground team may be necessary before vehicles are dispatched over it.

b. *Unfavorable Weather Conditions.* Unfavorable weather may ground aircraft, or visibility be such that the air observer cannot accomplish his mission.

c. *Enemy Air Defense.* Enemy air defenses may prevent aircraft flying over a chosen area. Army Aviation depends upon slow speed to facilitate observation and reconnaissance and its aircraft are normally unarmed; hence, its vehicles are especially vulnerable to enemy fighter and ground fire.

d. *Loss of Secrecy.* Secrecy may be lost when air reconnaissance is employed since an aircraft flying in the forward area may alert the enemy.

96. Aerial Cover for Ground Reconnaissance

a. The aviator-observer team can greatly assist a combat reconnaissance patrol. By observing ahead and on the flanks, this team can increase the security and expedite the movement of the ground party, and otherwise render invaluable service. The following types of assistance to the ground patrol are most common:

- (1) Observing over crests and around curves, thereby saving the ground patrol time and necessity of scouting on foot.
- (2) Locating enemy roadblocks and ambushes, and finding alternate routes or detours around them.
- (3) Reporting condition of roads and bridges ahead and locating detours around impassable road stretches or washed-out or destroyed bridges.

b. The aerial observer may be able to locate nearby construction material to repair impassable roads and bridges, and can report location of materials to the ground party for subsequent use by engineer units in improving routes for the main force.

c. Radio reports can often be relayed back to the unit by the air observer from his elevated position, which provides greater communication distance than from the ground.

d. The air observer can spot enemy patrols or columns and warn the ground party against surprise attack.

97. Route Reconnaissance

The purpose of route reconnaissance is to determine if a certain unit or units can use specific routes. Examination of roads and bridges to the extent required by engineer reconnaissance (par. 99) is not necessary. An observer reconnoitering a route should—

a. Determine the general condition and types of roads and bridges.

b. Estimate the carrying capacity of roads in terms of traffic density.

c. Locate any roadblocks on the route, and estimate the amount of material or equipment required to reduce them. (Roadblocks may indicate organized infantry ambushes.)

d. Seek defiladed routes.

e. Locate detours and alternate routes.

f. Estimate the number of route markers required.

g. Locate and observe enemy movement along routes of communication.

98. Aerial Position Area Reconnaissance

Aerial reconnaissance provides the artillery reliable position area information when time does not permit ground reconnaissance.

a. Aerial observers can evaluate terrain and vegetation and determine existing restrictions to fields of fire.

b. Locations of good observation posts can be established from the air by flying low over proposed OP positions. In this way, an accurate report can be given on the observation potentialities of available OP's.

c. Natural cover and concealment available to the unit can be observed from the air, and an estimate made of the artificial camou-

flage necessary to complete the concealment of the unit. The unit can thereby move into position with the least amount of damage to existing vegetation and concealment facilities.

d. Natural and artificial obstacles evident from the air can be evaluated in terms of the work necessary to reduce them.

e. Favorable routes of approach, departure, and communication between positions can be determined.

99. Engineer Reconnaissance

Engineer reconnaissance can be classified as specific reconnaissance or area search.

a. *Specific Reconnaissance.* The data sought through specific engineer reconnaissance are too varied and detailed for the scope of this manual. In general, specific reconnaissance obtains information required for engineer planning of construction, improvement, or demolition of specific roads, bridges, railroads, pole lines, airfields, stream crossings, minefields, or other obstacles in friendly or enemy territory. Engineer reconnaissance of roads and bridges can be adequately accomplished only by specifically qualified personnel. The effectiveness of defensive works, barriers, and demolitions is also determined by specific reconnaissance. The observer for such missions should be a qualified engineer officer. If the observer is other than an engineer officer, the unit engineer should furnish him with detailed briefing instructions. Rotary wing aircraft are more suited to such missions than fixed wing aircraft.

b. *Area Search.* Area search is used when location of engineer reconnaissance objectives are unknown. Its purpose is to locate sources of engineer supplies, equipment, or building materials; sites for airfields; water crossings; water points; storage areas; road nets; detours; and routes of communication.

100. Signal Reconnaissance

Army aircraft are used extensively for signal reconnaissance. This includes reconnoitering the axis (par. 101) of signal communication; observation and reconnaissance of routes for troop movements (par. 97); reconnaissance of areas prior to the selection of bivouac areas (par. 98), CP sites, or radio relay stations; observation of the route during a road march (par. 97); and reconnaissance of wire routes.

101. Axis of Communication

By definition, an axis of communication is a line through the probable successive locations of a unit's CP's. The unit commander designates the general CP areas, and insures that a personal reconnaissance is made to select specific locations. Army Aviation is

used to make an aerial reconnaissance of proposed areas prior to making a ground reconnaissance. If one site is not satisfactory, a brief flight takes the reconnaissance officer to an alternate site. Air reconnaissance, however, does not replace but only supplements ground reconnaissance, to facilitate the selection of CP areas.

102. Selection of Radio Relay Sites

In areas where terrain characteristics make the location of suitable sites for ground radio relay stations difficult, aircraft provide a means of rapid reconnaissance for these positions. The ability of rotary wing aircraft to hover makes the rotary wing aircraft particularly adaptable for this type mission. Selection of radio relay sites is a function of the command signal or communications officer. After he has tentatively selected possible sites by map or ground reconnaissance, the suitability of the sites and access roads thereto may be verified by aerial observation. To accomplish this the aviator flies from the base radio station toward the first site selected from the reconnaissance. When he reaches the first position, he visually searches for intervening masks. If these are present, he reconnoiters other sites selected from the map or by observation. If there are no masks, he proceeds to the second site and repeats the procedure. This continues until he has reconnoitered all the proposed sites for the required radio relay stations.

103. Wire Routes

a. Planning. The planning of wire lines is the responsibility of the unit signal or communication officer. This planning includes the type of line and the route. To determine the type of line, the primary factors to consider are the type of equipment available, the number and quality of circuits required, the length of the line, and the time available for the installation. Selection of the route is based on the requirements of the tactical situation and on map study, supplemented by aerial and ground reconnaissance. The unit signal or communications officer uses organic aircraft, if available, to make his initial reconnaissance. In this way, he can avoid difficult terrain, decreasing the amount of special construction needed and improving speed and efficiency.

b. Line Route Maps. After the unit signal or communication officer has made his aerial and ground reconnaissance, the route is selected and the wire laid. It is then necessary to prepare a line route map to show all actual and proposed wire circuit routes for the unit. This map is used to report the physical location of wire lines, the types of construction, and the number of circuits in each section of the line. As a final precaution, the unit signal or communication officer can make an aerial reconnaissance of the wire

lines to insure that all lines have been constructed according to the line route map.

104. Reports

Information obtained by reconnaissance must be transmitted accurately, clearly, and rapidly. Any or all of the methods of reporting (par. 86) may be employed. When the reconnaissance covers a long route or large area, marked maps or overlays with conventional signs and symbols are particularly useful for recording and reporting information. In addition to the conventional signs and symbols prescribed in FM 21-30, other symbols may be devised and used for brevity, provided they are clearly understood both by the observer in the air and the using personnel on the ground. Standard symbols for reporting engineer road and bridge reconnaissance data are listed in FM 5-34.

Section IV. AERIAL PHOTOGRAPHY

105. General

a. Mission. Aerial photography by Army Aviation provides Army commanders with limited tactical aerial photographic coverage. This coverage is intended to supplement, not to supersede or duplicate, photographic service rendered by other agencies. Army aerial photography includes daylight, vertical, and oblique photography with mounted cameras, and night vertical photography.

b. Capabilities. The most important characteristic of Army aerial photography is the speed and/or timeliness with which photographs are made available to using or requesting agencies. Rapidity of operation results from close proximity of signal and aviation units to the scene of action, simplicity and directness of communication, and familiarity of aircrews with terrain over which operations are conducted. Army aerial photography is hampered less by adverse weather than high-performance aerial photography since Army aircraft operate at lower altitudes and at slower speeds.

c. Limitations. Army aerial photography is limited to spot, strip, and mosaic type coverage of small areas due to smaller format cameras and to the limited processing equipment available. Furthermore, the lower performance characteristics of Army aircraft make them vulnerable to enemy harassment fire.

106. Responsibilities

a. G2 (S2). Coordination and staff supervision of Army aerial photographic missions is the responsibility of G2 (S2) at each echelon. Responsibility consists of (1) establishing policies and procedures for mission requests, (2) reviewing and establishing

priorities of requested missions, (3) coordinating photographic planning with signal and aviation officers at appropriate levels, (4) determining print distribution, and (5) supervising photography utilization. In establishing these policies and procedures, the G2 (S2) should bear in mind the capabilities and limitations of Army aerial photography discussed in paragraph 105*b* and *c*, if maximum benefit is to be derived from available effort. Since timeliness is a primary advantage of Army aerial photography, every effort should be made to prevent delays in the planning and execution of missions.

Note. Army aerial photographic equipment does not permit a large volume of work; therefore, thorough screening of mission requests is necessary to prevent overburdening of photography facilities and delays in print production.

b. Aviation Officer. The aviation officer is the special staff officer cojointly responsible for operational aspects of Army aerial photography. The aviation officer and signal officer (*d* below) share responsibility in advising the commander and G2 (S2) concerning aerial photography policies and procedures of the unit. *The aviation officer* under staff supervision of G2 (S2) is primarily responsible for supervising the planning and conduct of aerial photographic missions by Army Aviation units. His responsibilities include (1) the provision of aircraft and aviators for aerial photography, (2) training of Army aviators, observers, and photographers in planning and conducting aerial photography missions, and (3) maintenance of photographic equipment organic to aviation units.

c. Army Aviator. The Army aviator is responsible for planning, conducting, and completing individual photographic missions assigned.

d. Signal Officer and Photographic Officer. The signal officer, with the assistance of the photographic officer, is primarily responsible for and supervises the processing and distribution of aerial photography. The signal officer alone is responsible for the technical aspects of Army aerial photography, the operational aspects concerned with production and distribution of prints, and for advising the commander and G2 (S2) concerning aerial photography policies and procedures of the unit (*a* above).

107. Mission Requests

Aerial photography mission requests state the general requirements for completing an aerial photography mission and are forwarded through intelligence channels to G2 (S2) of the echelon at which Army aerial photography capabilities are available. Requests will be made on a standard air reconnaissance form and forwarded by the most expeditious communication means available

consistent with the urgency of the mission. Technical matters relating to the execution of a mission are primarily the concern of signal and aviation personnel.

108. G2 (S2) Processing

The G2 (S2) of the echelon at which Army aerial photography facilities are available processes aerial photography requests upon receipt from subordinate echelons. Requests are checked for completeness, and additional information is requested from the originator if required. They are also checked against existing basic, frontline, and special mission coverage available in the area, to determine if the requirements can be fulfilled with existing photography. In the event existing photography does not meet requirements, G2 (S2) or his designated representative will make the following decisions concerning a request in accordance with established policies of the command:

a. Determine whether the mission is justified in the light of required expenditure of effort and usefulness of the finished product.

b. If mission is justified, determine whether it is of such a nature (considering time and other factors) as to be an Air Force or an Army mission.

c. Determine whether the scale, type photo, and coverage requested is justified for the intended use or whether less expenditure of effort will meet the purpose.

d. If determined to be an Army mission, assign priority and obtain concurrence in or modification of print requirements and distribution.

109. Mission Planning

a. General. After G2 (S2) processing, mission requests assigned to organic aviation are forwarded by G2 (S2) to the aviation operations officer at the unit base airfield. If a G2 representative is on duty at the base airfield, mission requests may be forwarded through him to the aviation operations officer. After determining feasibility of flying the mission depending on the weather situation, mission planning is conducted by the aviation operations officer or his assistant. The aviation operations officer may be assisted in this function by the unit photographic officer or his representative, and by the G2 representative, if available. The aircrew that will fly the mission should be present and assist in planning, particularly on immediate-type missions. Mission planning includes any of the following which apply to the type mission being planned:

(1) Briefing on mission requirements.

(2) Briefing on enemy capabilities affecting the mission.

- (3) Determining the type of camera, lens, shutter, mount, film, and aircraft to be used.
- (4) Accomplishing plot of photographic objectives.
- (5) Determining altitude, scale, ground distance, and photo course lines.
- (6) Computing overlap and interval.
- (7) Computing film requirements.
- (8) Determining security classification and type marginal data required for prints.
- (9) Determining type prints, paper, and method of distribution.
- (10) Coordination with Army Air Defense Artillery.
- (11) Examining weather forecasts.

b. Technical Planning Factors. Technical planning factors for proper aerial camera utilization appear in appendix V.

110. Preflight Preparations

a. General. Preflight preparations are conducted by the aircrew which will fly the photo mission. On immediate-type missions, these preparations are concurrent with and immediately follow mission planning. They include items below, applicable to the type mission being flown.

- (1) Aviator:
 - (a) Weather check.
 - (b) Flight plan, to include altitude clearance for night mission.
 - (c) Arrangements for supporting fires.
 - (d) Arrangements for air cover (if required).
 - (e) Selection of entry and exit routes.
 - (f) Selection of filming and navigation checkpoints.
 - (g) Communication arrangements.
 - (h) Aircraft check.
 - (i) Arrangements for continuing identification to the Air Defense Artillery.
- (2) Photographer:
 - (a) Film loading.
 - (b) Shutter and light settings.
 - (c) Filters.
 - (d) Equipment installation and check.

b. Defensive Considerations. Defensive needs required for the aerial photographic mission must be considered during preflight preparations. During daylight hours, cover aircraft may be used to control artillery fire delivered in support of the mission. In addition, the sun and wind can be used to advantage by planning the direction of the filming course so that the sun will hinder the accuracy of enemy ground fire and the wind will increase ground-

speed over the objective area. Cloud layers should be utilized when entering and leaving the objective area. When selecting the route of entrance and the departure from the objective area, flight paths should be chosen which avoid known enemy concentration. When this is impossible, strong enemy defensive positions should be crossed during the first rather than the latter part of the flight. Aircrews should take sufficient time in mission planning to insure maximum speed of execution, thus reducing the time of exposure. During night missions, prearranged artillery fire, if used, is controlled by the pilot of the aircraft performing the photographic mission.

111. Filming Procedures

During aerial photo missions the aviator is in command and is responsible for establishing necessary communications and coordination with other agencies and with the photographer. He is also responsible for positioning the aircraft in such manner as to successfully accomplish the photographic mission. Development of trained aviator-photographer teams will increase efficiency of photographic missions. See appendix VI for filming procedures.

112. Developing, Printing, and Distribution (DPD)

The signal officer at each major echelon of command is responsible for the establishment and operation of facilities for developing, printing, and distributing aerial photos. Early establishment and prompt notification of location is essential if films are to be delivered for processing in the minimum amount of time.

a. Location. The best position for the location of the DPD point is at the unit airfield.

b. Processing. Processed photos must be sufficiently titled to provide the user with basic reference information needed for correct utilization of the photo. Cataloging and filing of negatives is the responsibility of the developing, printing, and distributing facility.

c. Distribution. Army Aviation may assist in the distribution of prints if other organic signal means are not adequate or available.

113. Tactical Use of Army Aerial Photography

The following examples show how Army aerial photography may assist ground elements:

a. Infantry Units.

- (1) Interpreting enemy defenses.
- (2) Designating line of departure.
- (3) Selecting covered routes of approach.
- (4) Orienting patrols.
- (5) Locating enemy troop concentrations.

- (6) Outlining enemy outpost line of resistance (OPLR) and main line of resistance (MLR).
 - (7) Locating civilian population centers, civilian movements and activities.
 - (8) Briefing aid in designating attack positions, objectives, etc.
- b. Artillery Units.*
- (1) Locating and preparing position areas.
 - (2) Supplementing map data.
 - (3) Locating position and determining type of enemy weapon emplacements.
 - (4) Indicating targets by the use of aerial observation posts (OP's).
 - (5) Collecting S3 information on target destruction.
- c. Armored Units.*
- (1) Evaluating terrain.
 - (2) Locating enemy units.
 - (3) Locating enemy antitank defenses.
 - (4) Planning route reconnaissance.
- d. Engineer Units.*
- (1) Estimating equipment and materials required for repair of damage.
 - (2) Locating ford and bridge sites and estimating required stream-crossing equipment.
 - (3) Locating obstacles, including minefields.
- e. Military Intelligence Units.*
- (1) Furnishing immediate tactical and topographical information to supplement, corroborate, and keep intelligence already on hand up to date.
 - (2) Verifying and evaluating information obtained by interrogation of prisoners of war (PW's) or friendly native personnel.
 - (3) Pinpointing enemy defenses and concentrations located through interrogation.
 - (4) Furnishing illustrations for intelligence reports.
- f. Signal Corps.* Aerial photographs are used by the Signal Corps to assist in the inspection and selection of—
- (1) The axis of communication.
 - (2) Wire routes.
 - (3) Bivouac sites.
 - (4) Command post sites.
 - (5) Radio relay sites.
 - (6) Microwave stations.
 - (7) Pole lines.
 - (8) Cable facilities.
 - (9) Camouflage.

g. Transportation Corps. Aerial photographs are used by Transportation Corps to assist in inspection and selection of—

- (1) Routes for ground transport operations.
- (2) Transfer and terminal sites and alternates in field Army area.
- (3) Aircraft maintenance and supply sites and alternates, and effectiveness of concealment and camouflage.

Section V. AERIAL SURVEILLANCE

114. Definition

Combat surveillance is a continuous (all weather, day and night) systematic watch over the battle area to provide timely information for tactical ground operations. The functions performed by combat surveillance are primarily collecting and reporting information for the combat intelligence system. Aerial surveillance is that part of the combat surveillance effort which utilizes aerial platforms.

115. Commander's Use of Surveillance

a. Offensive. The commander makes offensive use of surveillance to gain knowledge of enemy dispositions, forewarning of raid and flanking movements, attack routes, and attack objectives.

b. Defensive. The commander makes defensive use of surveillance to provide knowledge of enemy approach routes, concentrations, patrols, and aircraft.

c. Retrograde. The commander utilizes surveillance during retrograde movements to perform route reconnaissance, observe movement of forward elements of the hostile force, provide flank security, and move small tactical forces from and to blocking positions.

d. Special Operations. Information about remote or inaccessible ground areas, artillery fire needs for specific targets, special equipment requirements for movements, and possible landing areas for beachheads exemplify the commander's use of aerial surveillance in special operations.

116. Surveillance Techniques

a. Planning Surveillance Missions. Terrain analysis (par. 79b(1)) is particularly important in the planning of surveillance missions. The observing team considers the nature of the terrain as it affects the enemy's observation, fields of fire, cover and concealment, obstacles, and routes of communication. The whole area is then subdivided into zones or subareas to be searched.

b. Flight Techniques. Each of the subareas is then searched, beginning with those most critical to the mission or friendly forces. The flight path over each area is varied to insure observation from

several directions. For initial search, the aircraft is flown at a relatively high altitude to obtain a wide field of view. When indications of activity are noted (par. 80a), flying altitude is reduced sufficiently to permit detailed examination and identification of the activity. When the observer has completed examination of the target or activity, he returns to a higher altitude and repeats a general search of each subarea until indication of some other activity is noted.

c. Reports. Initial identifications are reported by the aviator as they are observed. Reports of changes (or negative reports) are usually made on a time schedule prescribed by the unit aviation officer during the briefing session (par. 79). A complete summary report, written or oral, is made at the end of the mission (par. 86).

Section VI. TARGET ACQUISITION

117. Target Acquisition Technique

Acquisition of artillery targets involves detection, identification, and location of targets in sufficient detail to permit target analysis and the effective employment of weapons. Detection is the discovery of the existence or presence of a target; identification determines the nature, composition, size, and other pertinent information for use in target analysis; location consists of the three-dimensional positioning of the target area to include likely avenues of approach into and through the area, and likely avenues of communications. Binoculars are used in the search of trails or shadowed areas where unaided vision would be insufficient. After the general appraisal, a more vigilant search to cover all avenues of approach, likely fields of fire, and suitable camouflage positions is made, with possible immediate spotting of artillery targets. This intensive search should easily detect movement and light flashes, but additional observations will require a meticulous and systematic scrutiny of the ground area. Several surveillance observation missions generally will be essential, and commanders must understand that initial failure in aerial detection of a specific target does not prove their absence. Increased familiarity and repeated aerial observation missions over the same terrain will gradually reduce the number of undetected targets.

118. Counterbattery Target Acquisition Technique

General or specific areas in which to search for enemy artillery activity may be found in intelligence reports such as hostile battery lists. When indications of such activity are detected in searching the enemy area, detailed examination from various observing angles is made to confirm the location and to fix its coordinates. In addi-

tion to indications discovered within the hostile area, clues to hostile artillery locations may be obtained by observing enemy fires falling in friendly areas and determining the direction of their origins.

a. Backsight Through Observed Bursts. An imaginary line drawn through two or more successive bursts or volleys fired at a single deflection setting will indicate the general direction in which the observer should search for the hostile battery (fig. 4). Depending upon the enemy's methods of conducting artillery fire, rounds fired for adjustment may be fired at differing deflection settings, and a backsight might lead in the direction of an enemy ground observer rather than the gun position. The aerial observer, therefore, accepts with reserve the direction indicated by successive single rounds. This is true especially if the time interval between rounds is fairly long. When he can determine that the hostile battery has begun fire for effect (a series of rounds or volleys fired into the same area at comparatively short intervals), he has better reason to assume that the deflection has been constant and that a backsight will lead him toward the artillery position.

b. Bisecting Side Spray. The side spray of a percussion burst is usually more apparent to an aerial observer than it is to an observer on the ground. The side spray gives the burst the appearance of an arrowhead, pointing back toward the gun. Backsighting along

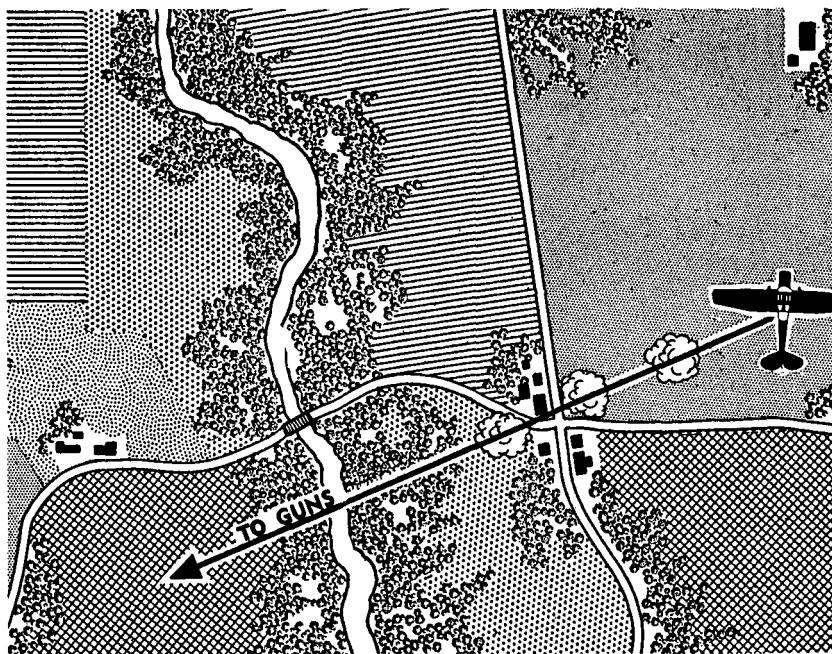


Figure 4. Locating the line of fire through backsight.

a line bisecting the angle formed by side spray will indicate the direction in which the observer should search (fig. 5). From an observing position directly over the burst, single rounds fired during adjustment may indicate the direction to the hostile position.

c. Direction From Airbursts. The pattern of an airburst serves as a good indication of the direction to a hostile battery. The pattern on the ground is generally crescent in shape, convex toward the gun, with the easily discernible longer axis of the pattern perpendicular to the direction of fire. Ricochet bursts from a similar pattern, but because of the erratic path of the projectile after impact with the ground, the pattern is not as dependable as that of an airburst in determining a direction to the gun.

d. Craters. With proper condition of soil and vegetation, the damage patterns described in *b* and *c* above may be easily recognized on the ground from the air.

e. Reports. Locations of hostile artillery positions are reported by the most rapid means available. The reports include coordinates, number and caliber of weapons, and the time and volume of any firing observed. Frequently, the observer is directed to conduct counterbattery fire upon the hostile positions which he has located and reported (par. 86).

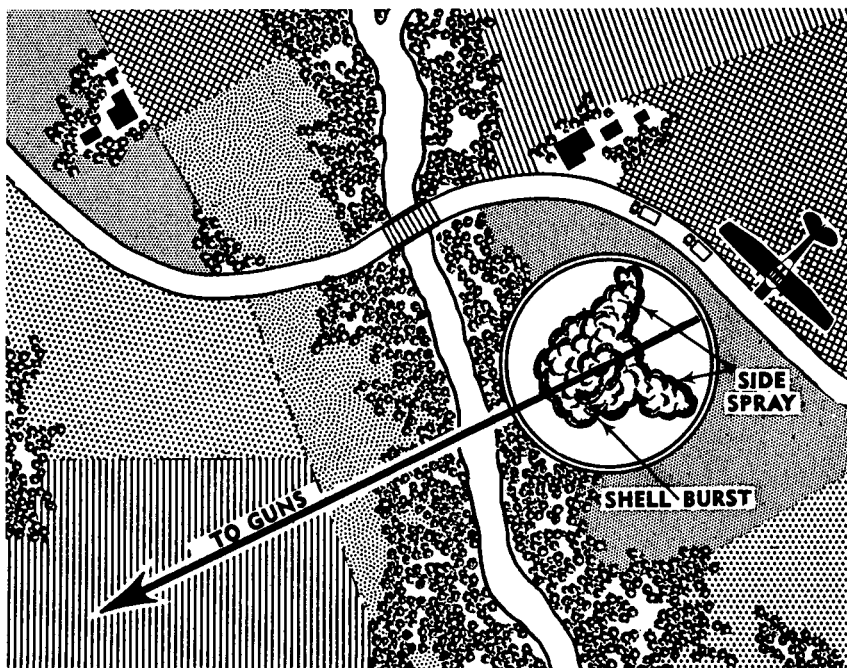


Figure 5. Bisecting side spray to locate the line of fire.

Section VII. CONDUCT OF FIRE

119. General

Army Aviation observation capabilities provide both mobile and semifixed observation posts for effective adjustment of fire support weapons. Maximum flexibility in securing prompt and accurate fire support is obtained by training all Army aviators and observers in the conduct of observed fires, regardless of their basic branch. Detailed discussion of procedures employed in adjustment of artillery, mortar, and naval fire is found in FM 6-40 and FM 6-135.

120. Target Offset

Because his observing position constantly changes, the observer must be aware of the effect of the target offset (the apparent shifting of the target with respect to the reference line). He should select points on the ground which will aid him in remembering the correct reference line. Figure 6 shows a single burst viewed from three different aerial positions and illustrates the variation in aspect which results from a changing target offset. In this situation, a well-trained aerial observer would keep in mind the reference line (FM 6-40) previously established, and would visualize the line running along the ridge, regardless of his position at the moment of the burst. His changing position will assist in making a more accurate sensing.

121. Locating the Burst

Rough terrain, trees, poor visibility, or the color of the background may make location of bursts difficult. This is particularly true of the first burst on a new target or in a new area. A burst from smoke shell is readily visible under all daylight conditions, and may be used for the initial round. As an aid to the observer, the artillery fire direction center may transmit the warning word "SPLASH" five seconds before the end of the time of flight of the projectile. This warning is especially necessary when high-angle fire or long-range artillery is being adjusted.

122. Flight Techniques

The combined requirement of speed and accuracy in the adjustment of fire requires the application of techniques which are familiar to all observing teams.

a. Orientation. In addition to visualizing the reference line, the observer should select a prominent terrain feature or object near the target to facilitate identity of the target if he becomes disoriented during a turn in flight.

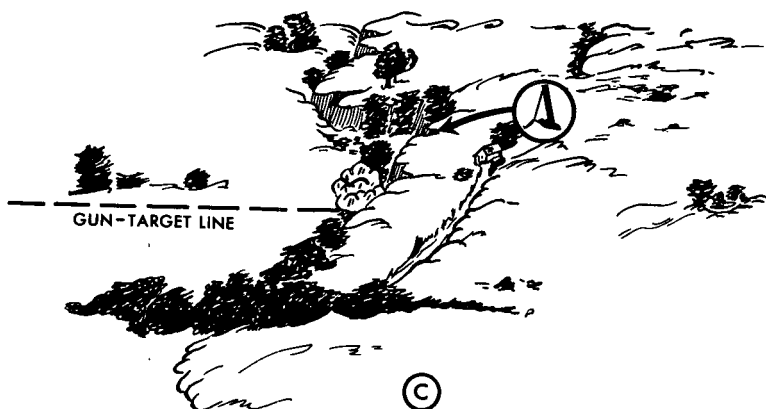
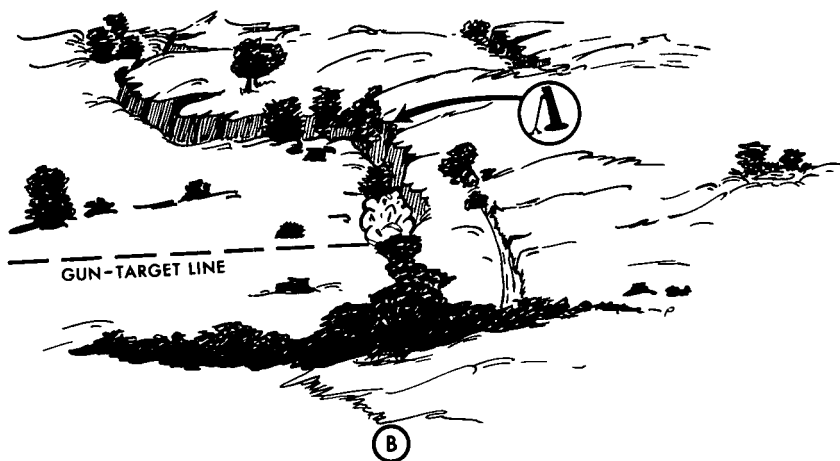


Figure 6. Target offset.

b. Flight Path. Flight paths in fixed patterns should be avoided since they enable enemy ground observers to determine the course, speed, and altitude of the aircraft and to bring accurate fire upon it. A small circular pattern over the target also invites hostile ground fire. Generally, the flight path should parallel the friendly frontline and, whenever possible, should keep the aircraft between the sun and the target. When friendly air defense weapons are available, the flight path should be planned to take advantage of their fire (par. 81).

c. Altitude. The aircraft is flown at that altitude which will afford the best observation without undue risks. It is determined by mission, terrain, visibility, enemy ground fire, disposition of friendly indirect fire weapons, and flight pattern to be employed.

d. Turns. The aircraft should be flown straight and level for best observation of bursts. If an aircraft turn is necessary, the pilot should complete it by the time the round bursts. If the aircraft is flying parallel to the reference line on its windward side, turns should be made into the wind to avoid drifting across the line of fire.

Section VIII. CAMOUFLAGE INSPECTION

123. Frequency

a. The unit commander or his aviation officer should inspect the camouflage of the unit from the air as soon as the unit has occupied a position. Commanders of units having no organic aviation may arrange with adjacent units for such inspection flights or make a request for camouflage inspection to the next higher headquarters.

b. Inspection flights should be frequent and at regular intervals: at least once weekly. Installations at the focal point of heavy traffic should be inspected at least twice weekly for vehicle tracks. Daily inspection should be made of camouflage vegetation to determine the extent of its blight. Positions in snow-covered areas should be inspected daily. For a discussion of camouflage methods and materials, see TM 5-267.

c. Aviators and observers should habitually note the condition of camouflage of friendly units if the nature of the air mission permits. Camouflage deficiencies or breaches of camouflage discipline should be reported at once.

124. Flight Technique

a. Speed. To permit detailed study of camouflage, fly aircraft at minimum safe flying speed.

b. Flight Path. When there is reason to believe the enemy may be observing, prolonged circling over a camouflaged area should

be avoided. The flight path of the aircraft should be such as to create the impression that observation in enemy territory is the mission.

c. Altitude. Inspect camouflage from high and low altitudes; high for a general study of the entire area; low for detail.

d. Angles of View. Since the enemy can observe the camouflage position from all directions, including the rear, inspect the area from all sides as well as from overhead. Time flights to take maximum advantage of the sun and to evaluate shadows that may reveal camouflage faults.

125. Use of Aerial Photographs

Prior to occupation of a new position, the area should be photographed from the air. After occupation, the area should be rephotographed periodically and compared with the original photograph to detect and correct differences. Photographs are particularly useful checks of the texture of artificial camouflage materials.

Section IX. TOPOGRAPHICAL SURVEY

126. General

Rotary wing aircraft are better suited than fixed wing aircraft for support of survey operations, although either type aircraft may be used. Army aircraft employed in the support of units conducting topographic surveys generally use the following methods:

- a.* Aerial reconnaissance for survey planning.
- b.* Movement of survey teams and equipment by aircraft.
- c.* Low-altitude intersection operations.
- d.* Low-altitude angle-of-site operations.
- e.* Low-altitude resection operations.
- f.* High-altitude photographic operations.
- g.* Radar operations.

127. Low-Altitude Intersection

a. Instruments are set up and oriented at two or more known points. When possible, radio communication is established between the aircraft and instrument operators. The instrument operators track the aircraft, and, when it is over the desired point, a pre-arranged signal (radio or visual) is given; all instrument operators stop tracking and record their instrument direction readings. The point of intersection is then computed, and the location of the point is established.

b. The relative accuracy of this method of topographical survey target location depends upon the following factors:

- (1) Altitude of the aircraft over the desired point; the greater the altitude, the more difficult it is for the aviator or air observer to determine when he is directly over the point.
- (2) Ability of instrument operators to track accurately and smoothly on the same point of the aircraft throughout its flight. Tracking the rotor mast of a rotary wing aircraft presents little difficulty.
- (3) Timelag between the aviator's recognition of his position over the desired point and his transmission of the prearranged signal.
- (4) Timelag between each operator's receipt of the prearranged signal and his cessation of tracking.
- (5) Size of the angle of intersection; the smaller the angle, the greater the cumulative effect of the possibilities for error.

128. Low Altitude Angle-of-Site

a. When only one known point can be occupied by an instrument operator, the aircraft is tracked both horizontally and vertically until the prearranged signal is given. Tracking is then stopped and both horizontal and vertical angles are read. This method requires that the altimeter (aircraft or surveying) be set at the altitude of the airfield or other point of known altitude before the mission is flown. The aviator reports his altimeter reading over the desired point. The difference in altitude between the instrument and the aircraft represents the side opposite the measured vertical angle. This permits a trigonometric solution for the adjacent side, which is the horizontal distance to the desired point. A ray is then drawn on the chart at the measured azimuth and the topographical survey target is plotted at the computed distance.

b. This method involves all the possibilities for error listed in paragraph 127, plus several additional ones as follows:

- (1) The instrument operator must attempt to track smoothly and accurately in two directions simultaneously.
- (2) Computation for distance is based on an altimeter reading, which is not precise. (Altimeter readings are actually measurements of atmospheric pressure which, with altitude remaining constant, varies with locality and is continuously affected by atmospheric conditions.)
- (3) Computation for distance is based on the extremely acute vertical angle at the instrument; a small error in reading will cause a large error in distance computed.

129. Low-Altitude Resection

In this method of point location, a rotary wing aircraft is used since the aircraft must be positioned over a point with considerable

accuracy when making instrument readings. Instruments are set up at points whose locations are to be determined. They are zeroed on any distant point for reference. Instrument operators track the rotor mast as the aviator positions the aircraft over one known point. When in position over the point, the aviator gives a prearranged signal (radio or visual). Instrument operators record their instrument readings and again zero their instruments on their reference points. In this manner, the horizontal angle between the reference point and each of the known points is determined at each instrument position. Horizontal angles between the known points can then be determined and the location of each of the instruments found by a three-point resection computation (FM 6-120 and TM 5-235).

130. High-Altitude Photographic Method

a. When the situation prohibits flight over the desired target at low altitude, the following method may be used. An aerial camera is mounted in an aircraft to permit vertical photography. Instruments at two or more known points track the aircraft. Upon prearranged signal, both instrument operators record direction, and the photographer simultaneously takes a vertical picture. The location of the aircraft is determined by intersection; the center of the photograph is the point on the ground directly under the computed intersection.

b. The accuracy of this method depends upon the same factors as those described in paragraph 127. An additional error is introduced if the camera axis is not exactly vertical at the instant the picture is taken.

c. Fixed wing aircraft, especially those equipped with self-contained navigation devices, are preferable for these operations because they can climb to higher altitudes and travel at faster speeds.

131. Radar

a. A variant of the method described in paragraph 128 employs radar instead of optical instruments. The radar location should be surveyed accurately and radio communication provided from the aircraft direct to the radar operators. The aircraft is flown as nearly as possible on a line from the radar location toward the target. If the target is in a radar clutter area, the aircraft is flown from beyond the target toward the radar. The radar operator locks the radar on the aircraft and places the radar in automatic tracking. Automatic tracking of a rotary wing aircraft is inaccurate due to the large rotating surfaces of the main rotor blades. This problem is eliminated if the tracking is performed manually. Each radar indicator is monitored and, at the aviator's radio signal, all readings are taken simultaneously. A ray is projected from the chart posi-

tion of the radar at the measured azimuth. Horizontal distance to the target (or photo center) is computed (radar's slant-range reading multiplied by the cosine of the elevation angle), and the point plotted.

b. This method involves inaccuracies because of the aviator's error in location, signal timelag, and timelag for the radar operators' responses to the signal. The last effect may be reduced materially if the radar is equipped with an automatic plotter.

Section X. ARTILLERY SURVEY OPERATIONS

132. Procedures

Without large-scale maps of an area or when terrain or the tactical situation are such that the division artillery and artillery battalion survey parties are unable to extend survey control along the ground rapidly enough to provide control to using units, a technique of survey employing rotary wing aircraft may be used. The principle of surveying with rotary wing aircraft is illustrated in figure 7 wherein a rotary wing survey base is established on the ground by division artillery survey parties.

a. The aircraft flies a predetermined flight pattern, stopping over designated points to hover. By using countdown procedures, simultaneous instrument readings are taken on the aircraft at each helicopter hovering point (HHP) by the division artillery base and by units in the division area. Coordinates and height of each hovering point are determined from the division artillery base by using intersection and are transmitted at a later time direct to the batteries of the division artillery. With the instrument readings taken at the battery and the coordinates of the hovering point, ample information is available for the computation of a three-point resection problem to establish locations of battery centers.

b. Although direction can also be established through these resection computations, it is not always reliable. Therefore, batteries should follow up the problem with an astronomical observation or participate in a simultaneous observation.

133. Reliability

Rotary wing surveys should be considered with caution. The reliability of data obtained by this technique is difficult to predict. Uncontrollable elements (winds, refraction, personnel reaction time, a mobile target, and the fact that rotary wing survey combines in intersection and resection two of the weaker methods of survey) make accurate extension of survey control along the ground difficult to obtain.

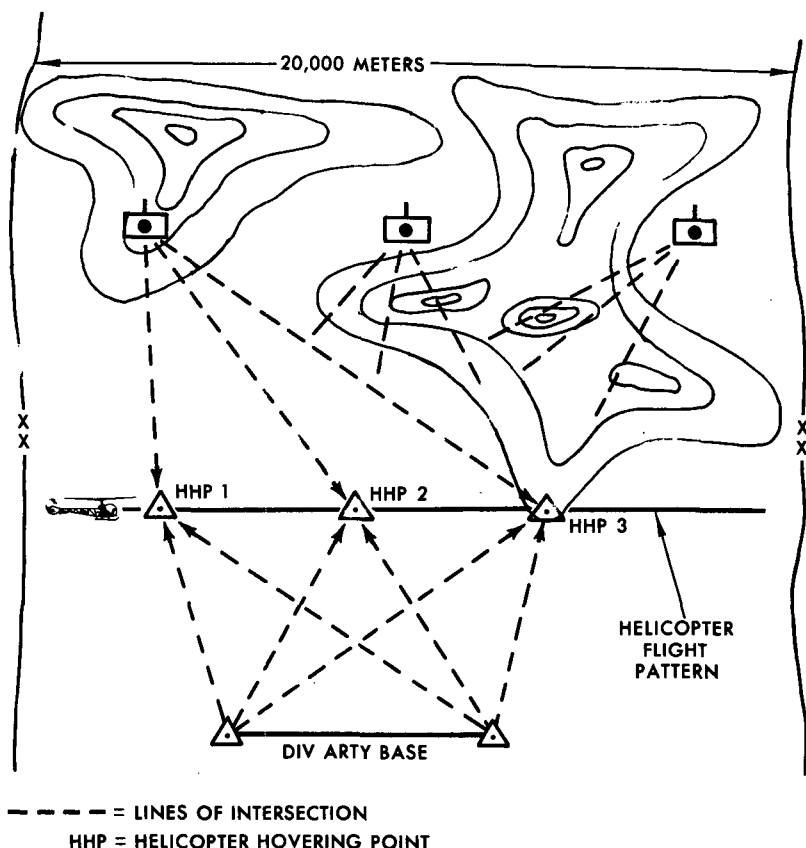


Figure 7. Artillery survey by rotary wing aircraft.

Section XI. RADIOLOGICAL SURVEY

134. General

The division aviation company has the capability and trained personnel for conducting aerial radiological surveys of residual radiation. The *preselected point* and the *preselected course* methods are used. A sample SOP radiological survey plan and interim survey procedures are found in appendixes VII and VIII.

135. Army Aviation Capabilities

Aerial survey can be accomplished on a small scale by any Army Aviation unit. The only limiting factor for units smaller than division aviation companies is the availability of suitable radiac instruments and trained monitors.

CHAPTER 8

COMBAT ZONE CASUALTY EVACUATION

Section I. GENERAL

136. General

Current weapons required increased dispersion and mobility. With the development of future weapons, higher casualty rates can be expected. These conditions require increased capabilities in medical evacuation. Aeromedical evacuation by means of organic Army vehicles for routine as well as critical casualties will provide the increased service required.

137. Advantages of Aeromedical Evacuation

Aerial ambulances have the following advantages over other means of medical evacuation:

a. Speed in Evacuation. Rotary wing aircraft can effectively shorten the time between wound infliction and applied surgery.

b. Flexibility. Maneuverability of rotary wing units enables the Army surgeon to shift his support quickly to any embattled units.

c. Casualty Comfort. Rotary wing evacuation can minimize the casualty's shock from handling and provide him transportation to the proper medical facility in better condition.

d. Selectivity. The use of aerial ambulances enables transport of casualties immediately to that medical facility best equipped and staffed for particular types of wound.

e. Economy. Aeromedical evacuation permits specialization in designated treatment facilities and eliminates cumbersome staffs required to care for patients having injuries of all or most types.

f. Morale. Past combat experience has proven that morale is better when the possibility of evacuation by air in the event of injury is known.

Section II. ARMY MEDICAL SERVICE AERIAL AMBULANCE UNITS

138. Organization

Army Medical Service aerial ambulance units are allocated to a field army to provide aircraft for rapid movement of emergency-

type casualties. These units are capable of unit administration and maintenance to include organizational maintenance of aircraft. Aircraft maintenance, other than organizational, will be provided by established Transportation Corps aircraft maintenance units. Aerial ambulance units will normally maintain sufficient supplies and equipment for adequate continuation of medical treatment during flight and to effect property exchange as required.

a. For purposes of economy, effective control, and the facilitating of operations, aerial ambulance units normally are assigned to a field army under operational control of the surgeon. The operating rotary wing platoons or sections will normally be located with the forward combat hospitals and will be provided normal administrative and logistical support by the hospital commander. Individual aircraft may be located at forward medical treatment facilities where patients are expected, or to augment the evacuation systems of forward combat units. Effective employment of such units requires their assignment to command levels which know both the forward tactical situation and the medical situation in the field army hospitals to include specialized surgery facilities.

b. Aerial ambulance units will normally be located in the area of the supported unit while performing evacuations for that unit. Ordinarily, aerial ambulance units or their elements will not be under the operational control of a command lower than field army for the reason given in *a* above.

139. Mission

The primary mission of Army Medical Service aerial ambulance units is to provide on-call aircraft for rapid evacuation of emergency-type casualties from forward combat units. This does not preclude necessary utilization of such units for other than emergency casualties, nor does it preclude the use of nonmedical aviation organic to a tactical unit in the aeromedical evacuation role.

140. Secondary Missions

Secondary missions of Army Medical Service aerial ambulance units include:

- a. Airlift of critical medical supplies.
- b. Aerial movement of medical specialist personnel.
- c. Lateral movement of patients to hospitals capable of providing specialized surgical treatment.
- d. Other evacuation missions as required.

141. Operations

a. Emergency-type casualties are normally evacuated directly from battalion battle group, or other unit medical facilities, upon



Figure 8. Emergency aeromedical evacuation.

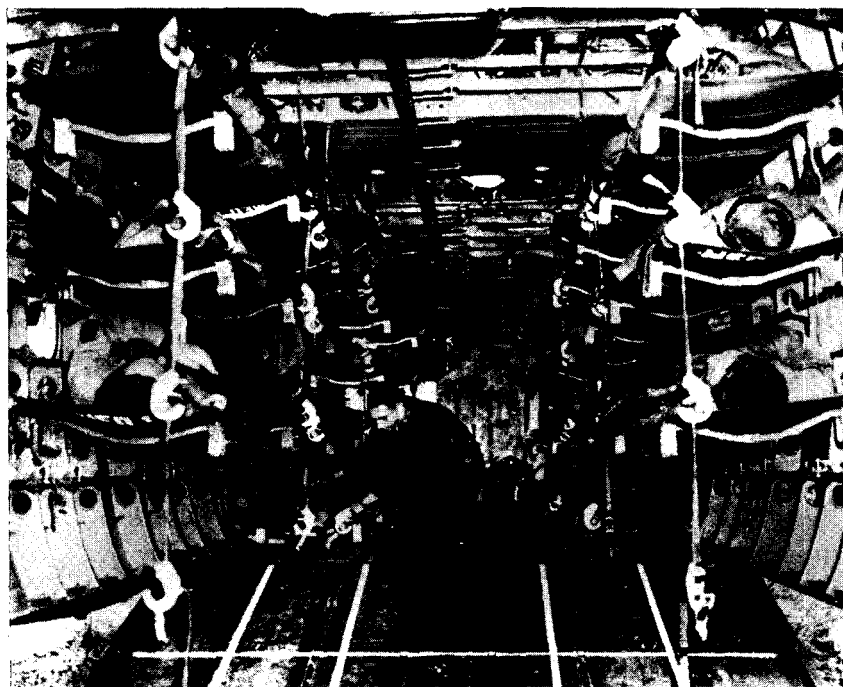


Figure 9. Medical service flight attendant.

request of the unit surgeon, to a designated field army hospital that is properly staffed and equipped (fig. 8).

b. There should be no intermediate delays or transloading.

c. Selection of casualties for evacuation and hospital destination are based upon medical considerations.

d. Aircraft assigned to these units are not special purpose in design but should be considered special purpose in utilization.

e. Medical service flight attendants will be provided for each mission as feasible (fig. 9). The emergency-type casualty normally requires detailed medical attention during flight.

Section III. ADDITIONAL AEROMEDICAL EVACUATION MEANS

142. Organization

Division, corps, and field army aviation units have the capability of augmenting Army Medical Service aerial ambulance units specifically to meet emergency peak casualty requirements and for movement of casualties on a scheduled basis.

143. Mission

Under most circumstances, requests placed on nonmedical aviation units will be for evacuation of the routine-type casualty. This type casualty does not require such expeditious movement nor degree of selection of the destination medical facility. Normally the routine casualty may be held for reasonable periods of time pending arrangements for his evacuation and, if properly prepared for evacuation, usually does not require medical attention in flight.

144. Planning

Medical staff officers at each level of command will assist the coordinating staff in estimating requirements as far in advance as possible for additional aircraft for aeromedical evacuation, and will program this support with agencies controlling such aviation. Plans will include providing, if required, necessary medical attendants and equipment, and designating forward pickup points and destination hospitals.

145. Operations

The accomplishment of aeromedical evacuation by nonmedical aviation units will be based upon requests by the surgeon to the aviation officer. The aviation officer will assign aircraft by type and number within priorities established by the commander. In addition to the requirements given in the previous paragraph, appropriate medical agencies are responsible for—

- a.* The movement of casualties to and from aircraft landing sites.
- b.* Rapid loading and unloading of casualties.
- c.* Providing replacement of medical equipment lost incident to evacuation by nonmedical aircraft.

Note. Normally item-for-item property exchange will not be attempted by nonmedical aviation units, and medical attendants will be provided if required.

Section IV. AEROMEDICAL EVACUATION OPERATIONS

146. Request for Aeromedical Evacuation

These requests will be processed through medical technical channels or command channels to the appropriate agency, normally the lowest echelon having appropriate aeromedical evacuation capabilities.

a. Requests for evacuation of emergency-type casualties will include—

- (1) Diagnosis of casualty(ies).
- (2) Identification of pickup point (map coordinates whenever possible).
- (3) Limiting factors in the landing area.
- (4) Report of weather conditions.

b. The surgeon at the command level will normally assign priorities to requests on the basis of casualty diagnosis and aircraft availability. The command which has requested evacuation of emergency casualties will be notified whether and when the pickup can be accomplished.

c. Requests for backup support from nonmedical aviation units will be initiated and presented by the surgeon through channels to the commander controlling the aviation units. Pickup of casualties will be under the operational control of the supported unit, except in evacuation of the emergency-type casualty by Army Medical Service aerial ambulance units. This emergency-type casualty control is exercised by the surgeon at the appropriate command level which is aware of field army medical conditions as well as the forward tactical and medical situation; hence, operational control should not be below field army level.

147. Standing Operating Procedure

a. The standing operating procedure of each command level will include policies for establishing priorities for evacuation of type casualties to include forward pickup sites, and other required procedures.

b. The command surgeon will coordinate with the aviation medical officer and aviation officer to initiate these policies.

Section V. TRAINING FOR AEROMEDICAL EVACUATION

148. General

Aviation units may have to augment services provided by Medical Service aerial ambulance units for medical evacuations. Aerial medical evacuation training includes:

- a.* Familiarizing supported, medical, and aviation personnel with proper request and disposition channels for this mission.
- b.* Designating and training medical and aviation personnel to assist in Army aircraft loading and unloading of casualties.
- c.* Giving first-aid training to aviators.
- d.* Establishing uniform visual signs to indicate pickup location of medical evacuees.
- e.* Establishing aircraft priorities for medical evacuations in accordance with directives.

149. Coordination Planning

Training in aerial evacuation should include procedures for the coordination of planning with aerial ambulance units (pars. 144-146).

PART THREE EMPLOYMENT

CHAPTER 9 GENERAL

Section I. BASIC PRINCIPLES OF EMPLOYMENT

150. Concepts

Army Aviation provides support to the commander which can greatly enhance unit versatility and flexibility on the battlefield in nearly all types of operations. In accordance with the same principles that govern the assignment of other support activities, Army Aviation units are organic to tactical and administrative units when habitual use and unit missions so dictate. On the other hand, where tactical and administrative units are nonhabitual users of Army Aviation support, aviation is pooled at higher echelons in order to provide this support and achieve maximum command flexibility. The essential quality of Army Aviation which is not available through other sources of air support is responsiveness. Army Aviation units provide commanders at all echelons with immediate battlefield support. Decentralization of Army Aviation support provides this responsiveness. The practice of pooling divisional aircraft in one company, for example, is followed to provide economy of maintenance effort and other logistical support. The support capabilities of the company, however, remain decentralized. Principles of war and their application to Army Aviation are discussed below.

151. Objective

Each aviation mission or operation must contribute to the ultimate objective of the supported unit in the most direct, rapid, and economical manner possible. Proper utilization and allocation of aircraft and careful screening of mission requests are basic to the effective application of this principle.

152. Offensive

Army aviators and Army Aviation units are trained for offensive combat operations; decisive results in wars are not normally achieved through the defensive. The aviation unit commander's initiative can greatly enhance the unit's opportunity for successful operations.

153. Simplicity

All aviation operations, plans, and orders must be simple to understand and execute. Even simple plans are usually difficult to execute in combat; therefore, all orders and operations must be reduced to essentials.

154. Unity of Command

Unity of command promotes unity of effort which, in turn, is furthered by willing and intelligent cooperation among all elements of the units involved. Direct support elements of an aviation unit receive and execute orders from the commander of the supported unit.

155. Mass

Army Aviation is so organized that the maximum aviation effort can be quickly massed at the critical time and place to achieve its objective. This principle of mass is most applicable to the movement of troops and supplies in the combat zone by Army aircraft, where, to avoid exposure to atomic as well as conventional fires, massed forces must be as mobile as possible.

156. Economy of Force

Army Aviation is employed either directly or indirectly to gain the objective. To achieve the objective, the principle of economy of force dictates that aircraft be utilized for essential tasks only and that minimum essential means be employed at points other than that of decision. Army Aviation units may be tailored for the accomplishment of a specific mission.

157. Maneuver

The principle of maneuver exploits the technique of positioning forces in relation to the enemy to achieve results which otherwise would result in heavy cost in men and materiel. The inherent characteristics of the aircraft plus the organization of aviation units enable Army Aviation to operate from unimproved areas and to move quickly to provide immediate assistance to maneuvering forces.

158. Surprise

Army aircraft must utilize the principle of surprise whenever possible because of their lack of armament and slow speeds. Surprise is achieved by secrecy, deception, variation in means and methods, and marginal weather operations.

159. Security

At present, the primary means of defense for Army aircraft, in the air and on the ground, is passive. Passive defense is effective to the extent that security is maintained. Security can prevent surprise and annoyance, preserve freedom of action, and retain control for the commander.

Section II. IMPORTANT FACTORS IN EMPLOYMENT

160. Training

New equipment and doctrine require continuous training of units and individuals if combat readiness is to be achieved. Training promotes efficiency, proficiency, and teamwork; see chapter 16 for details.

161. Planning

Planning is fundamental to the success of any operation. Coordination must be effected between all units and individuals directly or indirectly involved in an aviation operation. In other than routine missions, when sufficient time and materiel are available, rehearsals should be conducted to insure the best possible results.

162. Allocation of Aircraft

The ground commander is responsible for the allocation of aviation within his command. Aviation officers are responsible for advising the commander regarding the allocation of available aviation so as to provide the best possible support and utilization.

163. Utilization of Aircraft

Ground commanders are responsible for the proper utilization of aircraft within their command. The aviation officer given operational control over aviation units assumes full responsibility of commander in utilizing aircraft.

164. Decentralized Execution

Army Aviation units, regardless of size or composition, must be employed in a manner that will allow decentralized execution of functions. Although the aviation effort must be centrally controlled

within the command, support elements of the aviation unit must be capable of operating for, and with, supported units.

165. Vulnerability

Vulnerability of Army aircraft and aviation units is reduced by employment of the principles of surprise, maneuver, and security. Army aircraft may also be armed for self-protection; e.g., the arming of rotary wing aircraft with suppressive fire weapons. In addition, vulnerability can be reduced by counteroffensive surface-to-surface missile fire or by other means in the suppression of enemy air defense artillery fire.

166. Weather

Weather is a prime consideration in combat. Rotary wing aircraft particularly can operate under marginal weather conditions and commanders should take advantage of this fact. Improved aircraft instrumentation and air traffic control navigation systems will permit future operations during virtually all conditions of visibility.

167. Maintenance

The combat effectiveness of any unit, including those of aviation, is proportional to the state of maintenance of the equipment used by the unit. Proper allocation and utilization of aircraft can effectively decrease the maintenance workload. The maintenance program must be flexible enough to allow for rescheduling when maximum effort is necessary.

168. Terrain

Lack of availability of landing areas in jungle and mountainous regions is a primary consideration. This is more true of units composed of both fixed and rotary wing aircraft than of units composed of rotary wing aircraft only. Since aviation units will not be able to move their airfields as readily in these locales, initial selection of an airfield demands that the airfield be so situated as to allow for supporting operations for as long a period of time as possible.

CHAPTER 10

TACTICAL EMPLOYMENT

Section I. GENERAL

169. General

a. Army Aviation increases mobility of ground forces, effectiveness of firepower, and creates conditions for decisive shock action.

b. Army aircraft can place and/or relocate ground troops in more favorable tactical positions. They provide support for the development and advance of elements breaching enemy lines and for withstanding or containing enemy breaches of friendly lines. Flexible attachment of aviation units to combat elements permits maximum support for each tactical situation.

c. At present, Army aircraft cannot be employed closer to ground zero at the time of a nuclear explosion than that distance shown on a nuclear-damage template for unwarned exposed troops. For nuclear aspects of employment, see section V.

170. Employment of Fixed Wing Aircraft

a. Observation Type. Observation-type fixed wing aircraft are extensively employed in the field army as the primary observation vehicle to conduct artillery fire and to gather intelligence information. Limited cargo and troop movement capabilities restrict mass employment of these aircraft.

b. Utility Type. Utility-type fixed wing aircraft are employed in the field army for aerial photography, command liaison missions, and movement of troops, supplies, and electronic aerial surveillance equipment. This type aircraft is less maneuverable than the observation type, but may be employed from unimproved airfields.

c. Light Transport Type. Light transport-type fixed wing aircraft are organic to fixed wing transport aviation units at army levels. They are employed for movement of supplies and personnel within the combat zone. Cargo capacities and runway length requirements for these aircraft are discussed in FM 101-10.

d. Command Type. The command airplane is a multiengine, multipassenger airplane designed for aerial transport of command personnel.

171. Employment of Rotary Wing Aircraft

a. Observation Type. Observation-type rotary wing aircraft are small, highly maneuverable aircraft used primarily for command and short reconnaissance missions, wire laying, and battlefield pickup of casualties. They are most adaptable to the requirements for conducting aerial radiological surveys in which a ground correlation factor must be obtained. They are seldom employed in mass, although they are the most numerous type rotary wing aircraft in the field army.

b. Utility Type. Utility-type rotary wing aircraft are normally employed for aerial movement of troops, specialist teams, supplies, and medical evacuation of casualties. They are organic to the division aviation company, and are normally kept under centralized control for missions assigned by division G3 and the aviation officer.

c. Transport Type. Transport-type rotary wing aircraft are employed for movement of personnel, supplies, equipment, and aeromedical evacuation. Employment of these aircraft is discussed in FM 57-35.

Section II. EMPLOYMENT IN OFFENSIVE OPERATIONS

172. Basic Planning Considerations

a. Mission. The mission assigned Army Aviation is based on the mission of the supported unit, and normally appears as an annex to the operations order. This annex is prepared by the aviation officer. In situations where the size or urgency of the operation precludes the issuance of an annex, the aviation officer will recommend to the commander that the aviation tasks be assigned to subordinate units in accordance with standard practices and the tactical situation.

b. Weather. Weather forecasts covering the time of proposed operations greatly influence the aviation support plan. Climatological reports are utilized by the aviation officer in the early planning stages. The aviation support plan is adjusted on the basis of long-range forecasts (48 hours to 5 days) and short-range forecasts (48 hours or less). These forecasts are obtained from weather teams at each army airfield, and reports are transmitted from forecasters located at corps and army base fields. Unusual weather phenomena may cause major changes in the planned approach to the objective area. If this occurs, photographs are made of the new terrain to acquaint commanders with its detail and contours.

c. Terrain. Terrain is evaluated from the ground tactical view to determine possible landing sites, airfields, and command posts, and recommendations are made by the aviation officer for proper aviation support in the area involved.

d. Obstacles. Obstacles likely to confront the planned ground offensive operation are evaluated, and plans may be made for the movement of troops by air across or around them.

e. Cover and Concealment. Aircraft are employed to determine, simultaneously, the extent of friendly and enemy cover and concealment, and to locate potential targets for atomic weapons fire. Army airfields and aircraft are dispersed and concealed to the maximum extent practicable.

f. Avenues of Approach. Likely avenues of approach are determined from map studies. Reconnaissance missions are performed to confirm these avenues of approach, determine trafficability, and locate obstacles along them.

g. Aircraft Availability. Steps are taken to provide the required number of aircraft for each mission. Early warning orders are sent to all supporting aviation units, and additional aviation support is requested when needed. Maintenance is accelerated and rescheduled to assure maximum availability of aircraft throughout the planned operation.

h. Aviation POL. Aviation POL is provided in adequate quantities at strategic locations. Transport aircraft may be used to position POL needed for other aircraft. (If aviation class IIIA items cannot be positioned so that all aircraft can refuel within their sectors, individual aviation officers will schedule aircraft flights to permit minimum departures for POL positioned in rear areas.)

173. Distribution of Force

The aviation officer recommends to the commander the distribution of organic aircraft to support an operation. Such recommendation is usually made through the Army Aviation Support Plan Annex to the operations order.

a. Main Attack(s). Aircraft assignment priority is given to the main effort. Careful and continued studies are made of the mission and scheme of maneuver of the supported unit, and aircraft are assigned to best support the ground commander's plan.

- (1) The aviation officer will coordinate and time aviation missions to assure maximum support of ground elements and to prevent unnecessary duplication of effort.
- (2) Rehearsals will be conducted if time and equipment permit.
- (3) Flight commanders supporting assault elements will maintain close coordination with these elements to perform immediate missions as required.
- (4) Aerial observers used in the main effort should be the most capable of those available and fully acquainted with the tactical plan.

b. Secondary Attack(s). Army aircraft assigned to support the secondary attack(s) are kept to the minimum required for accomplishment of this phase of the offensive operation. (In addition to the normal employment, these aircraft may be used to aid in the deception plan by such techniques as numerous landings, passes over the objective area, or dropping flares on flanks of the objective area.)

c. Reserves. All available aircraft with suitable lift capability may be employed in aerial movement of key reserve forces as required. Reserves of troops or supplies may be airborne to arrive on call with the least possible delay.

174. Army Aviation Support Plan

The aviation support plan to the operation order (app. IV) is prepared by the aviation officer, based on the ground commander's plan, to include all phases of the operation and an estimate of aircraft required for each operational phase.

a. Estimates of Aviation Requirements. The aviation officer's estimate of aviation requirements for the tactical operation includes the following:

- (1) Mission and plan of maneuver of supported unit.
- (2) Duration of operation.
- (3) Intelligence requirements.
- (4) Expected aircraft losses.
- (5) Degree and extent of air traffic control required.
- (6) Weather information, to include cloud cover, natural light conditions and their expected duration, and other special conditions affecting operations.
- (7) Type and number of aircraft available.
- (8) Availability of landing sites.
- (9) Logistical requirements of aircraft to include POL and maintenance.
- (10) Availability of trained observers.
- (11) Location and availability of items for aerial resupply.
- (12) Communication and control facilities available to include navigation aids, vulnerability to electronic warfare (EW), state of communications training, and discipline of operators.
- (13) Mutual support economy to include observation, surveillance, and reconnaissance.
- (14) Number and extent of aerial radiological surveys required.
- (15) Type and number of supporting fires requiring aerial adjustment.
- (16) Location of atomic safety line (ASL).

(17) Security restrictions.

b. Planning Sequence. Preparation of the aviation support plan will generally proceed as follows:

- (1) Analyze the mission. Determine where and when Army aircraft will be needed.
- (2) Consider factors affecting accomplishment of the mission to include enemy, weather, and terrain.
- (3) Develop practical plans for support to include intelligence, scheme of maneuver, aerial adjustment of supporting fires, and logistic practicability.
- (4) Coordinate plan with supported unit.
- (5) Disseminate plan to all appropriate headquarters and aviation personnel.
- (6) Coordinate routes with air defense artillery.

175. Division Intelligence Requirements

Plans for the employment of Army Aviation include assignment of intelligence missions to supporting aviation units. Intelligence information desired generally includes the following types:

a. Information of the Enemy.

- (1) Locations.
- (2) Estimated strength.
- (3) Boundary locations and other details of enemy dispositions, especially locations of automatic weapons, armored vehicles, and artillery and atomic delivery means.
- (4) Locations of observation posts and command posts.
- (5) Enemy troop and civilian movements and supply routes utilized.
- (6) Location of logistic installations.
- (7) Daily routines of enemy units.
- (8) Effectiveness and location of enemy air defense artillery.

b. Information on the Weather.

- (1) Precipitation, height, and amount of cloud cover.
- (2) Visibility conditions.
- (3) Wind speed and direction.

c. Information on the Terrain.

- (1) Effects of weather on terrain trafficability and visibility.
- (2) Locations of areas adaptable to ground observation and fields of fire.
- (3) Locations which afford concealment and cover.
- (4) Locations and conditions of roads, rivers, dams, bridges, swamps, and other important terrain features.
- (5) Contaminated areas.

176. Army Aviation Support of Typical Offensive Actions

a. *Continuous Flow*. See FM 7-100 for description, conditions of employment, and characteristics of typical offensive actions. Aviation support (fig. 10) of this offensive action is as follows:

- (1) Reconnaissance and surveillance. Reserves may be moved by air to reinforce heavily engaged units. Aircraft aug-

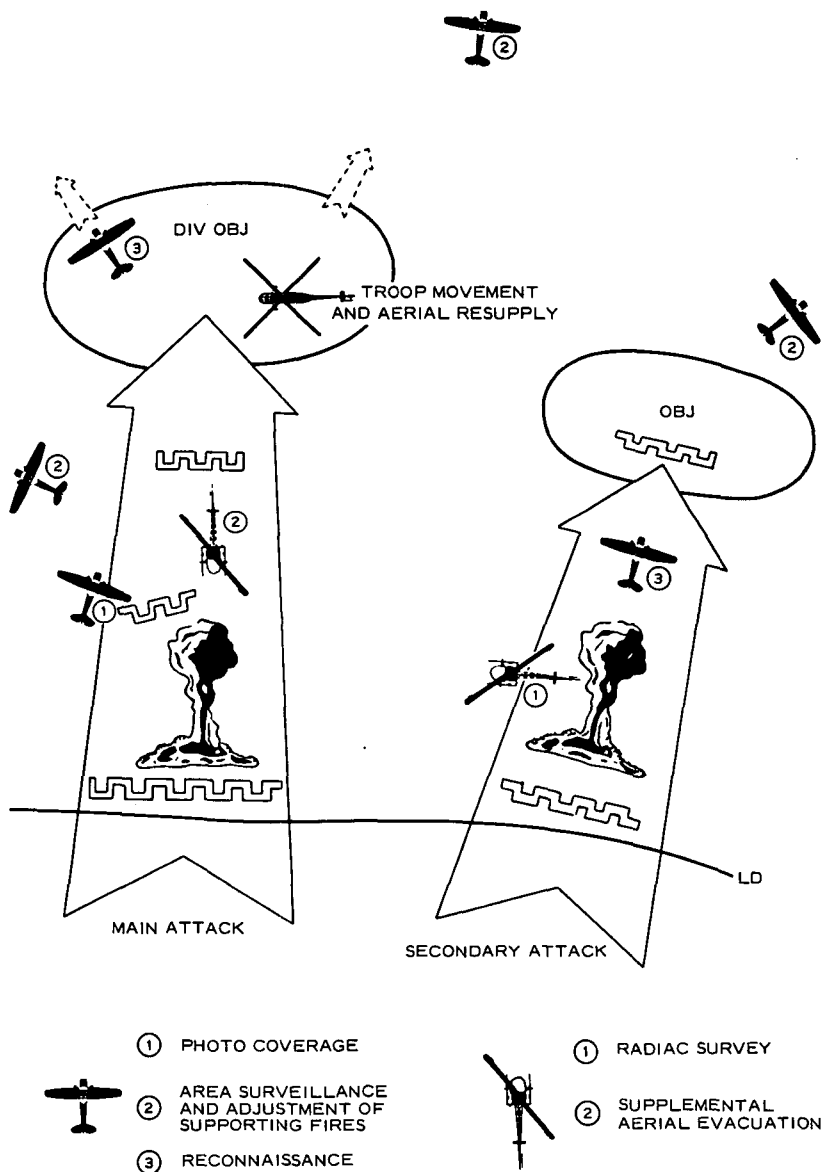


Figure 10. Aviation support of continuous flow operations.

ment Medical Service aerial ambulance evacuations and, if necessary, may be used for the purpose of expediting the reorganization of a reserve force.

- (2) Unilateral air-landed operations if required as augmentation to the main attack.
- (3) Accurate scheduling of aircraft support to assure proper maintenance and continued availability. Such maintenance is predominantly accomplished at night for greater daylight availability of aircraft.
- (4) Airfields and landing sites selected along the axis of advance. During early phases of the attack, area security of these sites cannot be assumed; consequently, aircraft normally do not occupy them at night.

b. Support of Mechanized Penetration and/or Envelopment. See FM 7-100 and FM 17-100 for definitions and conditions of employment. Surprise, speed, and violence characterize these operations. Figure 11 shows a typical technique of employing Army Aviation in support of these operations.

- (1) Normally, this type of offensive action will involve aviation elements from both infantry and armored divisions. Cooperation between aviation officers of the two divisions includes maximum use of aircraft and avoidance of unessential duplication of effort.
- (2) Unilateral air-landed operations of infantry are conducted to provide mechanized elements of the attacking force with maximum flank security and/or the seizure of critical terrain features.
- (3) Aerial resupply of mechanized force lead elements is provided to assure continued impetus of attack.
- (4) Rapid aerial identification of friendly mechanized elements is accomplished by panel display, marking-tape numbers, or other appropriate means of air-visible identification.
- (5) Aerial observers of infantry and armored divisions employ a common brevity code, measle sheet (fire plan overlay) of prearranged fire concentrations, and checkpoint reference system.
- (6) Specific aircraft are assigned the mission of target acquisition and damage assessment for long-range artillery to include missile units.
- (7) In mechanized envelopments, Army Aviation provides route reconnaissance and observations for flank security. Early aerial adjustment is made of supporting weapons fires on approaches likely to be used by hostile forces.
- (8) Bypassed enemy forces are kept under continued aerial surveillance, with propaganda leaflets and safe-conduct passes

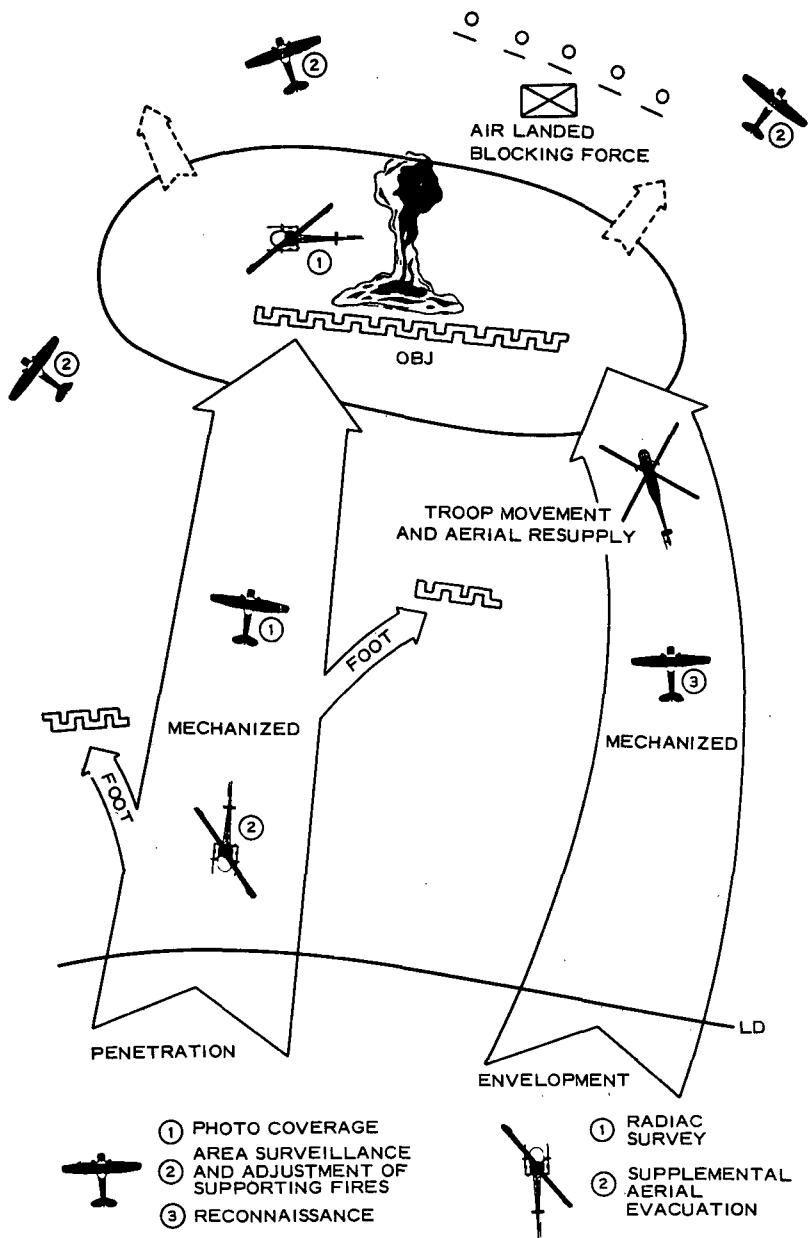


Figure 11. Aviation support of mechanized penetration and/or envelopment.

disseminated to these and other enemy elements as appropriate.

- (9) Location and destruction of bypassed enemy air defense artillery units is necessary to realize effective use of Army aircraft.

- (10) Partisan forces supporting the offensive action can be given aviation assistance by aerial transport of leaders, distribution of supplies, and dissemination of instructions.
- (11) Command and courier use of Army aircraft expedites rapid movement of commanders and command orders to assure positive control.

c. Support of Exploitation or Pursuit Operations. See FM 7-100 and FM 17-100 for definitions and conditions of employment. Aviation support of exploitation and pursuit operations are similar.

- (1) Air support is vital to a successful pursuit. Reconnaissance aircraft continuously observe vital points in the enemy's zone of retreat to keep contact with retreating columns, to locate any movement of hostile reinforcements, and to keep commanders informed of the hostile activities and movements within their zones of action. Both organic and supporting aircraft are used in providing this air support.
- (2) Air transportation may be required to furnish air-delivered supplies, particularly class IIIA, in order to keep the attack rolling and to maintain relentless pressure on the enemy.
- (3) To permit pursuit on as broad a front as possible, unilateral air-landed operations may be conducted on the flanks of mechanized columns.
- (4) Unilateral air-landed operations may also be conducted to canalize and impede enemy withdrawal, and to create hostile groupings ideal for atomic destruction.
- (5) Army aircraft may also be employed to illuminate hostile activities at night and to prevent loss of contact.

d. Enemy Air Defense Considerations. In supporting the above movements, consideration must be given to the enemy air defense capability. Failure to consider this important factor may result in reduced effectiveness of Army Aviation. Penetration, pursuit, or continuous flow operations in a mutually supporting defense in depth do not guarantee destruction of enemy air defense units by reason of the nature of the deployment. Therefore, location and destruction of enemy air defense units must be accomplished before free use of the air space can be enjoyed by Army Aviation.

Section III. EMPLOYMENT IN DEFENSIVE OPERATIONS

177. General

a. Organic Army Aviation may support position or mobile type defensive operations under either nuclear or nonnuclear warfare conditions. Aviation units primarily provide aerial surveillance on a unidirectional or multidirectional front. The enemy must be denied freedom of aerial observation to reduce nuclear vulnerability of

friendly defending forces; hence, Army Aviation and air defense artillery efforts must be closely coordinated to assure destruction of hostile observation aircraft without destruction of friendly aircraft.

b. Army aircraft are used extensively for security missions.

c. Camouflage inspection is especially important and is continuous on the part of all aviators and observers flying over main battle positions.

d. Nuclear fires, when used, dominate the defensive fire plan, and aviation officers must therefore expedite safe and prompt clearance of aircraft to prevent delay of these fires.

178. Planning Considerations for Aviation Support in Defense

a. *Terrain Evaluation.* Aerial reconnaissance by the commander provides a valuable supplement to map and ground reconnaissance. Map and aerial reconnaissance alone may prove adequate for tentative selection of likely areas to be defended, boundary selections, appropriate zones of responsibility, or adjustment of defensive sectors if necessary. Aircrews continually evaluate terrain for the purpose of furnishing information concerning suitable defensive positions to supported units. Factors aiding in the proper evaluation, recommendation, and selection of suitable defensive areas include—

- (1) *Key terrain.* Study should be made of critical features, avenues of approach, and available cover and concealment. Aerial observers must also search for suitable alternate defensive positions.
- (2) *Security.* For passive security, flights at altitudes or time-space frequencies which might reveal defensive positions should be avoided. Restrictions on the use of radios by aircrews may also be necessary.
- (3) *Mutual support.* Those units which cannot support each other with available weapons fire must rely on mobility for mutual support. The aviation officer must, therefore, consider their requirements and coordinate for necessary support.
- (4) *All-round defense.* Aerial observation on a 360° front may be needed in either a position or mobile defense. The aviation officer coordinates aerial observation to assure adequate coverage of all areas within the assigned zone of responsibility.
- (5) *Defense in depth.* Aerial observers must be completely familiar with the exact location of friendly defense positions to prevent possibility of firing on friendly forces.

b. *Coordinated Fire Plan.* In addition to requesting fire missions and adjusting and plotting fire concentrations, aerial observers

must know the proposed ammunition expenditure rate and the proper technique for requesting nuclear fires. Artillery and missile weapons now organic to the division require provisions for aerial adjustment and/or damage assessment of these longer range weapons.

c. Maximum Use of Offensive Action. The aerial observer's vantage point will often enable him to determine when and how friendly forces can gain the offensive. Early return of aircraft observers to nuclear-fire damage areas is essential in reporting damage, dose rates of radiation, avenues of approach through these areas, and possibilities for ground exploitation. Furthermore, the aerial observer's prompt and accurate reporting of facts about nuclear fires will help to dispel false rumors and other psychological after-effects which witnessing ground troops are likely to experience.

d. Chemical and Biological. Planning for the use of biological agents in support of defense, though done at corps and higher headquarters, may include utilization of Army aircraft for execution or delivery. Chemical screening smokes used to deny hostile troops observation of friendly positions may be adjusted from the air, and smoke generator units may be moved rapidly by aircraft to take advantage of existing wind conditions. Most chemical gases are colorless and their release will seldom be detected from the air; however, observers should report enemy troops wearing or carrying gas masks and report the sighting of possible chemical delivery systems. Samples of detected vesicants may be gathered and flown to higher headquarters. Gas masks which have a built-in microphone, such as those worn by tank crewmen, provide adequate visibility and voice clarity in radio communication if such masks are required for aircrews.

e. Counterattack Planning. The aviation officer recommends and coordinates the activities of aviation elements used to support the counterattack plan. Aerial observers determine the extent and location of enemy penetrations and aid in the direction of reserves to seal off these areas and expedite the annihilation of all hostile forces therein. Reconnaissance aircraft may be used as command vehicles in fast-moving situations to enable the commander to observe and control activities of his command.

179. Aviation Support for Mobile Defense (Division)

a. General. The objective of mobile defense is to defeat the enemy by combined defensive and offensive actions. The mobile defense is a highly fluid defense which does not permit rigidity in thought, tactics, or set patterns of action. Principal reliance is placed on bold and vigorous offensive action to destroy the enemy in a selected area most favorable to the defender. The flexibility and mobility

of Army Aviation units make them well suited to support such operations.

b. Security Forces. The mission of the division covering force is to detect the approach of the enemy, to delay and disorganize his advance, and to deceive him as to the location of the main force. Army Aviation assists the covering force by providing continuous observation and surveillance of the battle area, early warning of enemy approaches, and adjustment of long-range supporting fires on the enemy to delay and disorganize his advance.

c. Forces in the Forward Defensive Area. The mission of forces in the forward defensive area is to warn of impending attack; to delay, disorganize, and inflict maximum destruction upon the enemy; and to canalize him into a preselected area suitable for attack by the striking force and/or atomic weapons. Aircraft employed to support security forces, augmented by other aircraft, should also support forces in the forward defensive area after the security force has withdrawn into the forward defensive area. Army Aviation will provide the same type support that it provides for the division covering force (*b* above). Observers must promptly report all enemy movements and concentrations. Such reports influence the decision to employ atomic weapons and/or to commit the striking force. Army tactical transport aircraft may be used in the forward defensive area to move units from one strongpoint to another and/or to attack position on the flanks of advancing enemy columns.

d. The Striking Force. The mission of the striking force is to destroy the enemy by bold offensive action at a time and place of the defender's choosing. Maximum aviation support, placed under operational control of the commander, must be given to the striking force when committed to action. Additional aircraft may be obtained from corps or army to accomplish all aerial troop movement, logistical, and evacuation requirements. Since enemy forces may use the cover of darkness for greater security during movements, Army aircraft must be properly equipped to provide night support. Basic considerations and variations of the mobile defense can be found in FM 7-100 and FM 17-100.

e. Organization and Employment.

- (1) *Combat support flights.* Combat support flights will normally form the nucleus aviation support of the battle group. In a mobile-type defense, the combat support flight leader recommends allocation of aviation support to the battle group commander. To the extent practicable, the security and striking force elements should each have its own combat support flight to provide the commander with imme-

diately available aviation personnel for coordination of aviation support activities.

- (a) Flight leaders of security elements will primarily employ reconnaissance and observation aircraft, and perform continuous aerial surveillance.
- (b) Flight leaders of the striking force will normally employ organic utility or cargo aircraft. The section leader of the utility rotary wing aircraft may function as the aviation officer and coordinate activities of organic or attached rotary wing aircraft. This function is particularly advisable if the striking force is the division tank battalion, which normally will not have an attached combat support flight.
- (2) *Aerial surveillance platoon.* The aerial surveillance platoon, usually employed with the armored cavalry squadron and therefore part of the covering force, may be assigned the mission of night surveillance. This procedure will have added merit if ordinary aerial surveillance at night is inadequate.
- (3) *Artillery flight.* Artillery flight elements may be detached to support individual artillery battalions if so directed by the division artillery commander. Aerial observers are furnished by the supported unit.
- (4) *General support platoon.* Provides general support to the division and augments capabilities of the direct support platoon.

180. Aviation Support of a Position Defense

Army Aviation augments ground activities and security efforts in a position type defense (fig. 12). Aerial observation in support of this type operation is conducted to a depth equal to the range of organic artillery. Such observation for rocket and missile target acquisitions may require supplementation by high-performance aircraft. Early warning of hostile actions is obtained by continuous search of likely avenues of approach, with road junctions, trails, stream crossings, and similar critical targets marked by aerial observers for harassing and interdiction fires. Observers also maintain sentinel watch for breaches of camouflage or light discipline, and thus assure greater passive defense of the position. Although elements of the combat support flight normally will have landing fields within battle groups supported, these fields should be used only for pickup strips in a position defense because of their susceptibility to artillery and small-arms fire. Army Aviation is able to provide night illumination.

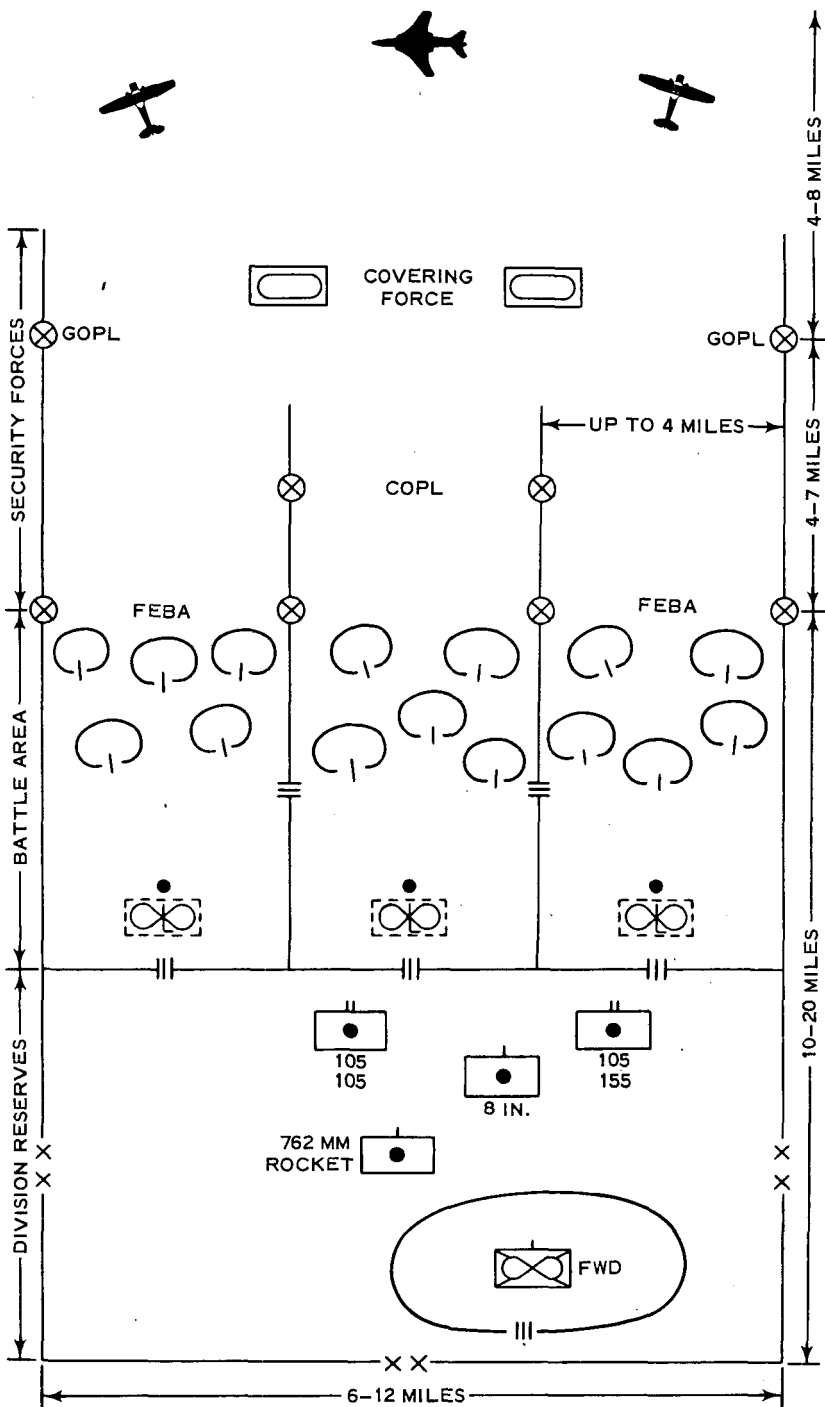


Figure 12. Aviation support of a position defense.

Section IV. EMPLOYMENT IN RETROGRADE OPERATIONS

181. General

Three types of retrograde operations normally employ Army aircraft support. These three are *delaying action*, *withdrawal from action*, and *retirement*. Aviation operations common to all three types include—

a. Detailed Centralized Plans—Decentralized Execution. The aviation support plan to include standing operating procedures must be detailed enough to provide support to specific combat elements of the division in the absence of orders or adequate communications. Aerial observation is provided at all times and in a consistent manner, with subordinate aviation personnel habituated to the concept of independent action as the situation requires.

b. Extensive Aerial Target Acquisition. Maximum attrition of enemy forces is fundamental to all retrograde operations. All justifiable targets sighted from the air, including sizable troop concentrations, are destroyed by any means of fire available. Aerial observers adjust weapons to likely avenues of approach to achieve deadly surprise fire for extensive annihilation of enemy forces.

c. Aerial Troop Movement. Army aircraft are employed to move foot troops to better defensive positions and demolition teams to appropriate areas as required. The division, however, will generally require additional aviation support for these aerial movements.

d. Security and Deception. The intention to withdraw must be kept secret and knowledge of the actual withdrawal must be denied the enemy as long as possible. Army Aviation aids in the deception plan by continuing its regular missions after friendly troops have withdrawn, being careful to keep aircraft over unoccupied areas and to avoid airspace gaps. Division security is improved by keeping enemy activities under constant surveillance throughout the planning, execution, and followup phases of the retrograde operation.

182. Delaying Action

Forces are committed to a delaying action to gain time at the expense of space. This is accomplished by blocking the enemy's path, compelling him to reconnoiter and to deploy his forces, or by engaging the enemy in time-consuming maneuvers. The extremely broad fronts on which delaying forces operate and the wide gaps which exist between adjacent units increase reconnaissance, observation, and transportation requirements. To meet these requirements, the force commander reinforces organic Army Aviation in each delaying zone, or allocates aviation to units that are without it. Primary missions for aircraft include continuous observation of the enemy's forces and his principal routes of advance, liaison with

adjacent units, visual patrol over any gaps through which the enemy might attempt to outflank delaying units, and timely information of the enemy's deployment in order to avert close engagement with him. Army tactical transport units increase the flexibility of the ground units by providing a rapid means of transportation for supply, evacuation, and the maneuver of forces.

183. Withdrawals

When units are withdrawn from a battle area, the secrecy of this action can be facilitated by continuing the previous patterns of aerial operations over the abandoned positions. In such cases, the aviation of the withdrawing units passes to the operational control of the force covering the withdrawal. First priority is given to observing and neutralizing hostile reconnaissance elements to prevent discovery of the withdrawal.

Section V. NUCLEAR ASPECTS OF EMPLOYMENT

184. General

The effects of nuclear explosions on troops, physiological (from blast, heat, and radiation) and psychological, require special attention when planning, training for, and conducting combat operations. Particular attention must be given to the training of Army Aviation elements in intelligence and logistic functions peculiar to the employment of these weapons.

185. Aircrew Hazards

a. Contamination From Cloud Penetration. Clouds resulting from an airburst of a nominal-yield weapon are generally nonhazardous if penetrated not earlier than 5 minutes following detonation; approximately 20 minutes is considered safe when penetrating clouds produced by megaton weapons. Filters on air intakes of aircraft, or respirators for aircrew members, are unnecessary. The internal hazard from ingestion or inhalation of fission products while within an atomic cloud is inconsequential compared to the external gamma hazard. Even when external doses are far above the lethal levels, the internal hazard remains within safe tolerance limits.

b. Contamination From Fallout. If aircrews do not receive hazardous doses from general fallout while preparing the aircraft for flight, the aircraft may be safely flown without prior decontamination. Decontamination by air wash and radioactive decay will do an adequate job without resorting to special washdown procedures which would needlessly expose ground personnel.

186. Maintenance Crew Hazards

a. Contamination From Cloud Penetration. External gamma hazard to maintenance crews from contaminated aircraft is practically nonexistent except in aircraft contaminated by kiloton-yield clouds penetrated shortly after the time of explosion. In such cases, aircrews may receive an almost incapacitating dose, making return of the aircraft doubtful. If the aircraft is returned, it should be parked downwind and time allowed for the rapid decay rate to reduce contamination to an operationally safe level. When penetrating clouds, contaminated areas of the aircraft are heaviest where a sharp change in the direction of airflow exists, such as the nose and the leading edge of a wing, in areas where air is trapped or filtered, or areas where excess grease or oil is found. Standard gamma survey instruments, such as the AN/PDR-39, are adequate for measuring contamination on aircraft. Maintenance crews may safely work on such contaminated aircraft without undue hazard provided simple precautions (wearing gloves, etc.) are taken.

b. Contamination From Fallout. Maintenance operations will be dictated, in general, by dose rates prevailing in the area in which personnel work, rather than the radiation field or contact hazard resulting from contaminated aircraft. In case of contamination of aircraft due to fallout, the limiting factor is chiefly the external gamma dose rate encountered due to the surrounding contaminated area. Hazards to maintenance crews from contaminated aircraft are the same as those discussed in *a* above, but are far below the gamma hazard resulting from contaminated areas.

187. Effects on Aircraft

Army aircraft can withstand the blast effects created by a nuclear explosion, if these effects are not too severe and not negatively applied (i.e., pressure applied on top of wings). The most vulnerable components of an aircraft are Plexiglas, particularly flat plate areas and canopies, control surfaces, monocoque or semimonocoque elements of the fuselage, and cowlings. Damage to equipment and accessories of an aircraft depends largely on whether the blast reaches the interior.

a. Aircraft in Flight. The degree of damage to an aircraft in flight depends upon its direction of travel with respect to the shock wave, height, slant range from the fireball, and the weapon yield. Nuclear radiation at the time of detonation is of no practical consequence to the pilot, since the aircraft would be destroyed by thermal radiation or blast before it comes within range of significant nuclear radiation.

b. Parked Aircraft. Parked, unprotected aircraft may be severely damaged by nuclear blast effect and by flying debris. Their wings may be sheared; they may be lifted into the air, overturned, or otherwise damaged beyond repair. The tendency of aircraft to weather-vane may cause damage to the fuselage and tail structure. Since windows and doors of parked aircraft are often left open, extensive damage may result to delicate interior equipment such as electrical devices and flight instruments.

188. Methods of Reducing Nuclear Effects

a. Aircraft in Flight. Aircrews should wear light-colored clothing to reflect the heat given off by a nuclear explosion and prevent or minimize skin burns. Eyes should be shielded with dark glasses to reduce the possibility of flash blindness. Aircrews should always be on the alert for a nuclear explosion and should take the following actions if one occurs:

- (1) Quickly turn the aircraft away from ground zero.
- (2) If possible, fly upwind of the explosion to avoid contaminating aircraft and personnel.
- (3) Realize that most of the damage to the aircraft will occur within a few seconds: act accordingly.

b. Parked Aircraft. Damage to aircraft (par. 187b) extends outward from ground zero to great distances. This damage can be reduced by digging in and revetting aircraft and equipment.

189. Nuclear Aspects of Combat Intelligence

a. Detection of Nuclear Targets. Observers must make special efforts to detect and report suitable nuclear targets. Information which indicates concentrations of enemy personnel or materiel will receive priority handling because of the probable short duration of such concentrations.

b. Indications of the Enemy's Nuclear Capabilities. Special emphasis must be placed on measures designed to detect the enemy's nuclear capabilities. Information which indicates these capabilities is immediately forwarded to the next higher headquarters. Some indications of the enemy's nuclear capabilities are:

- (1) Appearance of special types of instruments, weapons, and installations such as launching sites.
- (2) Appearance of special types of clothing and equipment.
- (3) Unusual and heavily guarded movements in rear areas.
- (4) Creation of wide gaps in formations or withdrawals from forward areas.
- (5) Marked increase in enemy aerial reconnaissance and observation flights, and local air superiority missions.

- (6) Registration of very heavy artillery with high airburst.
- (7) Abnormal amount of digging in by frontline units.

190. Control Measures After a Nuclear Explosion

Airborne aviators, observers, and intelligence personnel report nuclear explosions to the appropriate air traffic control center by means of the general air communications network. These reports may be supplemented by information obtained from special survey aircraft. Using information obtained from these reports, assigned personnel at control centers plot the *air radex* (a contour representation of the contamination pattern of the nuclear cloud and its predicted path and rate of travel). By use of the air radex, operations officers at control centers reroute aircraft to avoid the contaminated area.

191. Radiological Survey

Aerial radiological survey is the most rapid and the safest method of determining in the earliest stages the extent of radiological contamination. The primary advantage of such a survey is that it can be conducted regardless of the destruction or the ground radiation dose rate in the bombed area. For a complete discussion of aerial radiological survey, see paragraphs 134 and 135 and appendix VII.

192. Decontamination of Aircraft

a. Aircraft decontamination requirements will depend upon the extent of physical damage to the aircraft and whether contamination takes place both internally and externally. Where the degree of external contamination is beyond the capacity of immediately available facilities, or where there is internal contamination of aircraft and engine, time must be allowed for the radiation dose rate to decay to an operationally acceptable level.

b. If time permits, advantage may be taken of the natural decay of radioactivity before washing contaminated aircraft. For washing aircraft, a regular firehose, equipped with fog or spray nozzles, is satisfactory. In some instances, a sprinkling system can be used. If fog or spray nozzles, or sprinkling systems, are not available, water pressure must be reduced to avoid damaging the aircraft. Some sort of detergent should be added to the water to help remove contamination attached to greasy or oily surfaces. Precautions must always be taken for the disposal of contaminated waste and water.

c. After washing down, the aircraft will be monitored to determine the extent of decontamination. If decontamination is not sufficient to permit operation without undue hazard to the crew, the decontamination process should be repeated, and time allowed for natural

decay to reduce the radiation hazard to an operationally acceptable level.

d. Decontamination will be very difficult if an aircraft has flown through a nuclear cloud or has come in contact with nuclear particles while the engine is operating. The exterior of the airframe and engine should be washed thoroughly with water and detergent to decontaminate to an acceptable operational level. Internal parts of the engine may still constitute a hazard to maintenance personnel. If such danger exists, the engine should be appropriately tagged so that proper precautions will be taken when maintenance is performed. Overly radioactive parts, such as the carburetor, magnetos, and exhaust stacks, should be replaced as rapidly as possible.

e. Surface decontamination, aging and sealing, and disposal are the three basic procedures employed in decontamination operations. Each of these methods has a unique purpose, and one can be used to supplement another.

- (1) Surface decontamination reduces the contamination without destroying the utility of the object.
- (2) In aging and sealing, the radioactivity is allowed to decrease by natural decay, then the remaining residual radiation is sealed onto the surface.
- (3) In disposal operations, contaminated debris and articles which are either badly damaged or which cannot be decontaminated, e.g., porous materials, are removed and burned or otherwise destroyed.

CHAPTER 11

DEFENSE OF AIRCRAFT

193. General

Defensive procedures used by Army Aviation vary with respect to mission, enemy capabilities, and terrain. These procedures must be consistent with successful accomplishment of the mission within acceptable loss rates, but should not overburden supporting agencies. For protective measures against nuclear employment, see section V, chapter 10.

194. Camouflage Painting

a. Camouflage painting of aircraft is one of the simplest forms of passive defense. Such painting makes aircraft detection more difficult and reduces their definition as a target.

b. Army aircraft, as viewed from above, should be painted so as to present minimum contrast to the terrain beneath. Such camouflage will hamper detection by enemy air, particularly with considerable altitude separation. In addition, such camouflage seriously handicaps enemy sighting and leading of the target. Top painting should be in various mottled shades of green, olive drab, and brown.

c. Camouflage painting to protect against ground fire is more difficult since the sky may be an even background or be in color contrast and in motion.

- (1) The use of an under color with good sky-light color and reflection characteristics will reduce detection at relatively high altitudes, particularly under conditions of poor visibility or reduced sky light. The primary advantage of under color is that it presents a poorly defined target thereby rendering tracking on visually controlled light air defense artillery weapons extremely difficult once firing has begun and muzzle smoke hinders observation.
- (2) A very light blue or blue-white color with reflection characteristics comparable to average sky light may be used on under surfaces of combat observation aircraft.
- (3) Under color is normally useless on rotary wing aircraft since their operational altitudes are so low. Rotor blades,

however, should be painted a neutral color to reduce light reflection.

- (4) In night combat operations, aircraft exhaust flame suppressors should be used.

195. Armor Protection

Armor may be used to protect crews of observation aircraft and, to a lesser extent, crews of other types of Army aircraft. Crew compartment armor normally consists of light nylon laminate curtains (flak curtains) installed in the sides of the crew compartment and on the bottom and back of seats. This armor has sufficient density to stop small flak fragments and slow down or deflect larger or higher velocity fragments and small-arms fire. In addition, crew protection may be obtained by use of lightweight body armor consisting of vest, trousers, and possibly head protection. Self-sealing fuel tanks are installed in certain types of aircraft to prevent or minimize possibility of explosion or the scattering of flaming fuel if tanks are hit, and to prevent loss of fuel from battle damage.

196. Air Warnings

Timely and accurate warning of hostile air activity is primary since it defends Army aircraft against all hostile air action by permitting appropriate defensive measures prior to attack. Air warnings are most accurate in the vicinity of friendly air intelligence agencies and diminish in value as the individual aircraft proceeds deeper into enemy territory and farther away from air warning agencies. An air warning and emergency channel disseminates warnings to Army aircraft in flight. Air warning broadcasts are accomplished by flight operations centers in each corps and army service area. In addition, airfields are equipped with receivers for reception of air warnings on the established air warning net. These airfields can retransmit air warnings over tactical channels to those in-flight Army aircraft not equipped with auxiliary warning receivers.

197. Air Defense Weapons Fire Protection

Air defense weapons fire affords protection to Army aircraft but diminishes in effectiveness as the aircraft proceed deeper into enemy territory. Army aircraft operating in advance of friendly ground elements will receive little or no protection from these weapons except as a haven of refuge when attacked. However, these weapons do afford considerable protection to Army aircraft operating near them. Every pilot should know the radio channels and the locations of friendly air defense units so that the unit to which he is proceeding for protection can be alerted. Communication can also be accom-

plished through fire support channels or air traffic control channels, but this means is not as satisfactory as direct communication.

198. Artillery Fire

Friendly artillery fire directed against enemy ground-fire capabilities affords significant protection to Army aircraft on combat missions. Friendly artillery fire may accomplish specific fire missions against enemy air defense artillery and other targets by providing suppression fires, and by delivery of smoke to cover certain operations. Protection afforded combat aircraft by friendly artillery progressively diminishes as the aircraft proceeds deeper into enemy territory.

a. Combat observation aircraft utilize friendly artillery to deliver on-call neutralization fires on *definitely located* active enemy weapons emplacements. Once located emplacements have been rendered inactive, destruction fire is utilized to destroy individual pieces. A policy of prompt artillery fire on enemy weapons may, through threat, force the enemy to adopt more restrictive firing policy against Army aircraft. Specific fire missions in support of rotary wing assault or rescue operations prevent or restrict enemy movement of troops toward the combat landing area.

b. Suppression fires are delivered on all known or suspected enemy positions in a given area. These fires are intended to neutralize the effectiveness of enemy fires against friendly aviation during and immediately following delivery.

- (1) Suppression fires require considerable ammunition and are therefore not practical for defense of Army aircraft operating on long-duration combat missions such as surveillance, conduct of fire, or general reconnaissance.

- (2) These fires are practical for use in protection of specific short-duration, high-risk, combat missions requiring such additional protection; i.e., exceeding normal restrictions of altitude or flight paths imposed by enemy weapons capabilities. Such missions are aerial photography, low-level reconnaissance of a particular objective, assault rotary wing operations, and combat rescue missions.

c. Smoke delivered by friendly artillery is particularly useful to screen operations such as rotary wing rescue, rotary wing assault, combat resupply, and evacuation conducted within capabilities of enemy air defense artillery, small arms fire, or indirect fire weapons.

199. Fighter Aircraft Protection

In support of certain Army Aviation operations, fighter aircraft can provide fire support against ground targets. Fighter aircraft provide incidental protection to Army aircraft against enemy air

capabilities by establishing command of the air and by special air cover missions. The incidental protection given can be considerably increased by establishing a direct communication channel between aircraft and Air Force control and reporting centers. When attacked by enemy fighters, the pilot of the Army aircraft is able to call the control and reporting center in his area and secure prompt fighter aircraft assistance; they can be diverted by the control and reporting center to effect rapid interception. This procedure is also applicable with airborne tactical air controllers.

a. This type protection is particularly effective where fighter aircraft remain on air alert status in support of major operations of ground forces.

b. Special missions that justify use of fighter aircraft on the primary mission of protection of Army Aviation are relatively short-duration missions that involve mass movement of Army aircraft such as rotary wing assault operations or the flight of Army aircraft to a friendly airhead or beachhead.

c. Fighter aircraft may be advantageously utilized to provide fire support against ground targets in protection of rotary wing assault or rescue operations.

200. Complementary Army Aircraft Protection

Complementary protection is obtained by using one Army aircraft to cover another directly engaged in accomplishing the mission. Missions that justify this coverage are of relatively short duration and high risk such as low-level reconnaissance and aerial photography. When enemy air and ground fire is highly effective, operations of all combat observation aircraft in pairs may be advisable. In this type defense, the covering aircraft (1) protects the other aircraft against ground fire by directing friendly artillery fire in support of the mission; (2) decreases the possibility of surprise attack by enemy air; and (3) provides a rapid means of initiating aircrew rescue if the protected aircraft is forced down in enemy territory.

201. Evasive Maneuvers

Evasive maneuvers are a primary means of defense against enemy ground fire and enemy air capabilities.

a. Flight paths and altitudes must be continually varied to reduce enemy accuracy in making linear predictions for visually sighted ground weapons fire. Enemy accuracy is reduced by continual shallow turns and small changes in altitude and speed, coupled with more abrupt attitude, altitude and speed changes. Contour flying reduces aircraft vulnerability to radar controlled ground weapons and surface-to-air-missiles.

b. If attacked by enemy high-performance aircraft, the Army aircraft should descend to minimum altitude as soon as possible and evade the attacking aircraft on each pass by utilizing all terrain features possible until refuge or relief can be obtained. The high-performance aircraft, due to speed and maneuver differentials, cannot match the flight path of the low-speed observation aircraft and must make repeated firing passes at shallow-dive angles. The Army aircraft should take advantage of this characteristic by making a rapid, controlled descent from the initial attack altitude to minimum altitude levels. At the same time, the Army aircraft should keep the attacker in view and search for other enemy aircraft.

- (1) The descent is accomplished by turning inside the attacker's turns, and turning down and at a deflection angle toward the attacker immediately before he closes to firing range. The rate of descent is secondary in importance to observation and proper evasive turns during the descent.
- (2) When attacked by aircraft with similar maneuver capabilities, the Army aircraft should immediately begin a steep dive. The dive should be initiated toward the attacking plane so as to increase the rate of closure, thus decreasing the on-target time.
- (3) Alternating turns should be accomplished while losing altitude so as to present the most erratic target possible to the attacker. Recovery is made at an altitude low enough to permit contour flying.

c. The final refuge from enemy aircraft is within the range of friendly air defense weapons, in clouds, or by actual relief from friendly aircraft. Landing in friendly terrain may possibly secure crew protection if other sources of refuge are not available.

202. Altitude Selection

Higher altitudes minimize the effectiveness of light air defense fires; on the other hand, lower altitudes minimize detection and increase the ability to evade high-performance aircraft but may increase the vulnerability to guided-missile-type air defense artillery. If the enemy has high capability in both air and ground fire, the lower altitude operation short of effective range of enemy air defense artillery offers the best flight path. Night conditions render visually directed enemy weapons largely ineffective.

203. Electronic Countermeasures

Electronic countermeasures (ECM) may be employed when operating within enemy radar nets or the coverage of electronically directed fire weapons. Successful countermeasures against enemy

radar largely depend on accurate knowledge of enemy radar locations, types, frequencies, and coverage. Intelligence information of this type is obtained through electronic reconnaissance data secured by Army and Air Force electronic reconnaissance agencies. Metallic chaff may be dropped to clutter enemy radars. This is an inexpensive and simple method; however, its use is limited to short-duration missions. Another electronic countermeasure is the use of an airborne transmitter broadcasting on enemy radar frequencies. This measure is effective over long periods but involves considerably more weight and is operationally more complex. Thus, except when justified by heavy enemy capability in the field of radar-directed weapons, the airborne transmitter method should not be used.

PART FOUR OPERATIONS

CHAPTER 12 NIGHT OPERATIONS

Section I. GENERAL

204. General

a. Night operations are of particular importance to the commander. During periods of darkness, terrestrial observation is limited, the effectiveness of visually directed defensive fires is reduced, and the possibilities of being surprised are increased. The enemy may be expected to take advantage of periods of darkness to cover deployment, redistribute forces, and initiate offensive operations.

b. Night operations conducted by Army Aviation include surveillance, adjustment of fire, battlefield illumination, night photography, and logistic and service missions. All Army Aviation units are organized and equipped for habitual night operations.

205. Advantages

Advantages of Army Aviation night combat operations include:

a. Around-the-clock Army Aviation operations deny the enemy that freedom of action he would have under cover of darkness.

b. Acquisition of more lucrative targets for friendly artillery, and more intelligence of certain types than can normally be obtained during comparable daylight conditions.

c. Greater freedom of action at a time when enemy air defense measures are least effective.

206. Disadvantages

Disadvantages of Army Aviation night combat operations are indicated by the following requirements:

a. Better weather conditions than daylight operations.

b. Better airfields and airfield lighting.

c. Better electronic navigation facilities.

- d.* Limited use of aircraft caused by reduced visibility.
- e.* Additional coordination, control, planning, and training.
- f.* Artificial illumination for external load hookup.

Section II. AIRFIELDS

207. General

Airfields used for night operations should be defiladed from enemy ground observation. Whenever possible, fields should be selected that are free of obstacles at either end. When this is impractical, any obstacle which constitutes a hazard must be illuminated or otherwise made easily identifiable to the pilot. Most night operations require airfield lighting; on bright moonlight nights, observation aircraft may occasionally operate off unlighted airfields. Unit base airfields are equipped with portable field lighting sets (par. 321b); however, night operations conducted from other than base airfields may require field-expedient type lighting such as flare pots or flashlights.

208. Airfield Operations

Airfield operations personnel should maintain radio contact with airborne tactical aircraft based at the field. Takeoff and landing operations should be controlled by radio. Airfields are illuminated only during that period when takeoff and landing operations are being conducted if the tactical situation dictates the use of minimum airfield lighting.

Section III. NAVIGATION

209. General

During night operations, aircraft can be navigated by pilotage and/or dead reckoning if the aircrew is sufficiently familiar with the terrain. On dark nights, bodies of water and vehicle traffic moving along supply routes behind the light line may provide adequate points of navigation reference. In addition, searchlights used in battlefield illumination provide excellent checkpoints. If pilotage combined with dead reckoning is unreliable as a primary means of navigation, it must be supplemented by radio (electronic) navigation. LF/MF radio beacons, in addition to FM homing stations, are available at the base airfield of division, corps, and army. In all night operations, an alternate airfield equipped with instrument approach facilities should be designated for use when weather conditions preclude return to the departure airfield.

210. Night Orientation

a. Visual. Good atmospheric conditions with some degree of natural light reveal sufficient terrain features to permit accurate orientation without supplemental means. Under other conditions, supplemental means must be used for orientation. White phosphorous or illumination rounds fired on request from the aviator can be used to mark specific areas. Searchlights provide orientation by beam crossing or direct lighting of a specific area. Radar can be used in vectoring and position fixing of Army aircraft.

b. Electronic. Vectoring is the ground-controlled process of directing an aircraft over a selected course to a predetermined point. When using tracking-type radar, an initial pickup point and altitude should be selected over a visual checkpoint at which the radar can acquire and track the Army aircraft. After pickup, the radar tracks the aircraft, and heading corrections are transmitted to guide the aircraft over the desired ground track. In battlefield illumination this procedure is used to direct Army aircraft to flare-release points when visual control is inadequate. When so used, the aircraft is flown in a prescribed "racetrack" or other prearranged course for dropping successive flares. This procedure is also used for positioning Army aircraft over points to be photographed when sufficient visual orientation is unavailable. *Position fixing* is the procedure by means of which the aircraft position is determined at any given moment. Radar tracks the aircraft and positions are determined on request of the pilot. This procedure is primarily used in night photography to determine coordinates of photo centers.

211. Flight Planning

Flight planning for night operations must be more thorough than for comparable daylight operations. Elements of flight planning include obtaining weather information, navigation planning, communications arrangements, arrangements for orientation facilities if required, and filing of flight plans and altitude clearance. Coordination of Army Aviation night operations with air defense units and with Air Force air defense agencies is accomplished by the flight operations center as part of flight clearance procedures. However, coordination with air defense units is normally limited to those units with the capability of firing on unseen targets by means of non-visual control. Coordination with visually controlled air defense artillery elements organic to forward ground elements may not be necessary unless required by low-altitude night operations conducted in the immediate vicinity of particular units.

a. Selected flight paths between the airfield and the area of operations should avoid friendly visually controlled air defense elements

in forward areas. If this is impossible, a prearranged signal may be used by Army aircraft as a means of revealing their identity to these forward air defense elements.

b. All special communications and orientation arrangements required in night operations should be made prior to takeoff. Coordination with friendly ground elements must be accomplished if flares are to be used, to prevent lighting of friendly patrols in forward ground elements.

c. All aircraft used in night operations should be equipped with basic flight instruments.

d. The use of pyrotechnics requires stringent safety precautions which must be prescribed and followed (mountings and settings).

e. Every effort must be made to obtain and preserve night vision adaptability of aircrews prior to flight. Aircrews who anticipate night flight should wear sunglasses during the day. (Smoking and altitudes above 5,000 feet may reduce night vision as much as 30 percent.) Oxygen should be used during night operations.

Section IV. NIGHT OBSERVATION

212. Surveillance and Adjustment of Fire

a. General. Visual night surveillance can be accomplished with considerable success under favorable atmospheric conditions. Terrain features and road nets are clearly visible in moonlight. Certain objects or activities contrasting with their backgrounds are easily detected, especially vehicles or troops on the road, and particularly if the road surface is light in color. Lights displayed by the enemy and gun flashes from positions in defilade are more easily seen from the air than from the ground.

- (1) On dark nights, use of artificial illumination such as flares or shells permits a detailed search of specific areas; participating aircraft should carry flares for this purpose. Areas selected for illumination and detailed search from the air should generally be those areas defiladed from ground observation, suspect by past knowledge or current indications, and so located that the illumination will not adversely affect friendly ground elements.
- (2) Night surveillance is accomplished from positions over the enemy area at lower operational altitudes than comparable daylight operations. Because aircraft are less visible at night, except by radar, operation over enemy positions at low altitudes can proceed with minimum risk.

b. Observed Fires. The adjustment of fires at night is difficult due to problems of accurately locating targets, adjusting rounds, and assessing effectiveness of fire. On targets located near easily recog-

nizable terrain features such as roads and bodies of water, location and adjustment are relatively easy. On bright nights, other terrain features become partially visible and aid in locating targets and performing subsequent adjustment. Aircraft flares, illuminating shells, and searchlights may be used to provide illumination for adjustment of fire and orientation when natural light is insufficient. White phosphorous shell is normally used for aerial adjustment of artillery fire at night, since shellbursts are easily seen and location is visible for several minutes because of the burning embers.

c. Unobserved Fires. Many profitable targets located by aerial observation can be engaged by unobserved fires at night. Pre-planned concentrations on road junctions and other critical points and suspect areas may be fired on call when activity at these locations is observed. This method of attack is particularly useful against vehicles and troops moving on roads and trails, as well as against known enemy weapons. Targets found on dark nights, under conditions which make adjustment impossible, may be accurately located through use of aerial photography for subsequent attack by unobserved fires. In addition, approximate locations of active weapons may be determined by radar position fixes. When using this method, the aircraft flies a cloverleaf pattern over the target and several radar fixes are taken. The approximate location obtained from the mean of these fixes is sufficiently accurate for area fire data in favorable terrain or for comparison of locations with known positions on the hostile battery and hostile mortar charts. Aerial observers are seldom able to accurately evaluate damage at night unless fires or secondary explosions result; however, the accuracy and coverage of fires can be readily evaluated.

213. Battlefield Illumination

Battlefield illumination is the lighting of the ground combat zone of action by artificial means with the object of providing friendly forces with sufficient light to assist them in conducting ground operations at night and, where possible, denying the enemy the use of this illumination. Army Aviation is capable of providing rapid high-intensity battlefield illumination by means of aircraft flares.

a. Uses. Aircraft flares used in support of ground operations permit all ground weapons to be employed in their primary role and improve the morale and confidence of friendly troops. Like all pyrotechnics of battlefield illumination, aircraft flares provide sufficient light for aimed fire, surveillance under conditions approximating daylight, movement of troops and vehicles, minefield operations, evacuation of casualties, and resupply. Such flares also can be used to silhouette and harass the enemy and discourage infiltration.

b. Disadvantages. Aircraft flares temporarily reduce the night vision of friendly troops and create a hazard from falling parts if activated within friendly lines.

c. Flare Characteristics. All aircraft flares, except those for signaling, have very high light intensity, a slow rate of descent, and long burning time. While no flares have been designed specifically for support of ground action, certain aircraft flares are suitable for this purpose. See appendix X for the characteristics of aircraft flares.

214. Aircraft Flare Illumination Capabilities

Observation-type aircraft are capable of continuous flare illumination of one-half hour duration per sortie; utility-type aircraft, one and one-half hours per sortie. Army aircraft are particularly useful in battlefield illumination since they are immediately responsive to the commander. Control and accuracy are facilitated as a result of reliable and flexible air-ground communication, terrain familiarity, and relatively low operational speeds and altitudes of the aircraft. When conditions permit, flare-loaded aircraft can fly continuous cover for frontlines and deliver on-call illumination.

215. Technique of Aircraft Flare Employment

a. General. The use of aircraft flares in battlefield illumination should be adequately covered in standing operating procedures and operations orders to insure coordination, control, and timely availability. Even when on-call illumination is available from aircraft on air alert status, coordination is required to prevent possible exposure of adjacent unit operations. Effective ground control of aircraft must be exercised to achieve accuracy of delivery and to effect prompt changes in placing illumination as required by changes in the ground tactical situation. Alternate means of communication should be planned in the event of failure of the primary means. Commanders should plan and coordinate alternate methods of illumination in case of bad weather or when other conditions preclude or limit aircraft operations.

b. Requests. Requests for aircraft flare illumination missions by Army aircraft are submitted through command channels. Division or higher headquarters may assign the mission to Army aircraft, or the request may be forwarded through air support request channels. The unit requesting illumination will be advised of approval or disapproval. If approved, detailed coordination must be accomplished. Requests should include the following information:

- (1) Date illumination is required.
- (2) Purpose (manner in which ground forces intend to employ the illumination).

- (3) Duration of illumination requested (specific times, such as "3 minutes at 2150, 2240, 2310"; "1 hour 30 minutes continuous after 0145"; "on call").
- (4) Coordinates of the points or areas to be illuminated, or a clearly marked map.
- (5) Proposed means of control.

c. Control. Use of aircraft flares for battlefield illumination is controlled by the commander being supported. Surveillance, control, and adjustment of flare illumination by Army Aviation is effected through the artillery liaison officer. Direct communication between the ground controller and the aircraft must be established. Particular care must be exercised in determining the dropping point, since flares may be carried off target by the wind.

- (1) Initial flares should be dropped well beyond friendly elements until the direction, rate of drift, and altitude of burst have been established. The altitude of burst desired is that which utilizes the full burning time of the flare and still provides the desired intensity of illumination on the ground.
- (2) If orientation for dropping the initial flare is inadequate, illuminating or white phosphorous orienting rounds may be fired to identify the initial drop point to the aircrew. Subsequent flares are adjusted by the ground observer.
- (3) Under favorable weather conditions and after initial adjustment, the aircrew can maintain continuous illumination of the desired area from the light afforded by preceding flares, without further orientation or control from the ground observer.
- (4) Under poor weather conditions with insufficient ground orientation, radar may be used to control successive flare delivery after initial adjustment by the ground observer; however, communication is maintained with the ground observer.

216. Loading and Dispensing Aircraft Flares

Aircraft flares are loaded on the bomb shackles and/or inside the aircraft, released by means of a bomb release mechanism, or dispensed by hand. Flares require accurate fuze presetting to reduce firing malfunctions and to allow minimum free fall of the flare from time of release until the lanyard activates the firing mechanism.

Note. Flares loaded on bomb shackles must be preset prior to takeoff.

Section V. NIGHT AERIAL PHOTOGRAPHY

217. General

Night aerial photography is normally vertical photography performed with mounted cameras. Illumination is normally provided

by high-intensity photoflash cartridges. Since photoflash is short lived, there is little danger of unfavorable lighting of ground elements or of appreciably impairing night vision. However, night aerial photography missions conducted in the vicinity of friendly ground elements should be coordinated with those elements.

a. The value of most night aerial photography diminishes rapidly from the time photographs are taken; therefore, every effort must be made to expedite processing and distribution. Under favorable conditions, high-priority night photographs should be in the hands of the user not later than one hour after exposure.

b. Night aerial photography coverage is limited by the amount of illuminants that can be carried by the aircraft. Hence, the volume of photography is reduced as compared to daylight photographic operations. An additional limiting factor may be the unavailability of radar for control purposes.

c. When available, infrared photography should be used, as this type requires no artificial light and cannot forewarn the enemy.

218. Types and Uses of Night Photography

a. *Target Location.* Night aerial photography can precisely locate targets detected by other means. Army aircraft equipped for night photography can be used in visual night surveillance for gun flashes or other indications of enemy activity. Information available from photographs of the target area permits accurate location of the target for delivery of subsequent unobserved fire. A radar position fix may be used to determine the coordinates of the photo centers to facilitate processing.

b. *Target Reconnaissance.* Artillery target reconnaissance by means of night aerial photography increases the effectiveness of harassing and interdiction fires. All suspect areas are photographed at intervals throughout the night. Immediate evaluation of this photography permits attack of targets active as of the last coverage, necessary change of fire schedules, and, to some extent, rapid evaluation of the results of these fires.

c. *General Reconnaissance.* Reconnaissance by means of night aerial photography permits evaluation of suspect areas for general intelligence purposes; e.g., enemy routes, supply areas, command posts.

d. *Ground Action Evaluation.* When friendly ground elements are engaged in night defensive action, the lack of effective ground observation makes it difficult for the commander to evaluate the scope of such action and to reach a decision as to committing reserves. Night aerial photography can give the commander detailed information on ground action within stringent time limitations.

219. Technique of Employing Night Aerial Photography

White phosphorous or illumination shell for orientation purposes is not normally desirable for night aerial photography missions. White phosphorous shell produces smoke which tends to obscure the area being photographed, while an illumination shellburst will obliterate a portion of the negative if the photograph is taken with the illuminant between the camera and the target area. Also, on some type missions, use of pyrotechnics for orientation will forewarn the enemy and tend to reduce the value of the photograph. When light is insufficient for orientation purposes, radar should be used to vector the aircraft to the areas to be photographed. The use of cut film holders will expedite accomplishment of night photography since it permits the delivery of exposed film for processing at frequent time intervals, rather than when a complete roll is exposed.

CHAPTER 13

SPECIAL OPERATIONS

Section I. GENERAL

220. Definition of Special Operations

Special operations are types of military operations which require specialized troops, equipment, or techniques.

221. Adaptability of Army Aviation

In special operations, Army Aviation performs the same types of missions as in any other operations; however, modifications of aircraft or operating techniques may be necessary to fit the special characteristics of each type of operation involved. For nuclear aspects of employment, see section V, chapter 10.

Section II. AIRBORNE OPERATIONS

222. General

Airborne operations are operations involving the movement and delivery by air, into an objective area, of combat forces and their logistical support for execution of a tactical or a strategic mission. Joint operations primarily envision entry into the airhead by parachute or assault aircraft. Airmobile operations are primarily air-landed operations involving the movement of troops by Army aircraft in the combat zone. Airborne operations and techniques are discussed in full in FM 57-30 and FM 100-5. A limited discussion of air-landed operations is given in paragraph 45; for a complete discussion, see FM 57-35.

223. Concepts of Employment of Army Aircraft in Airborne Operations

a. Joint Operations.

- (1) When employed, rotary wing aircraft and other aircraft with vertical takeoff and landing characteristics extend the flexibility of airborne forces through their ability to land in areas otherwise accessible only to parachute units.

- (2) While the airborne force is still in the marshaling areas, Army Aviation is used primarily for liaison and courier missions.
- (3) In the assault phase of an airborne operation, Army aircraft may be employed to assist in supply and evacuation missions; for example, the distribution and evacuation of personnel and cargo within the airhead.
- (4) Army aircraft working with reconnaissance elements can be used to perform reconnaissance and area surveillance over wide fronts and extended distances through the use of a combination of organic troops, ground vehicles, chemical and biological detection devices, photographic equipment, television, airborne/ground radar, and infrared devices.
- (5) Rotary wing aircraft, in particular, may be used to position, reposition, and/or withdraw security elements and reserves within the airhead.
- (6) In accomplishing the ground linkup between the airborne force and the advancing land force, Army aircraft are employed to extend communications, identify units, and generally assist in the coordination and establishment of contact.

b. Airmobile Operations. Refer to FM 57-35 for details of unilateral operations.

224. Movement of Army Aircraft to Airhead

a. General. Army aircraft may be flown to the airhead under their own power, or they may be disassembled for transport in cargo aircraft. Disassembled aircraft may also be brought in later by ground transportation or ships. The method of transportation depends upon the means available, the tactical situation, distance covered, type of aircraft, and the planned mission of the aviation unit.

b. Flight to the Airhead.

- (1) Whenever possible, available Army aircraft will be moved to the objective area under their own power. Flights must be closely controlled and regulated to avoid interference with flights of the troop carrier elements. Navigational aids sited in friendly territory for use by troop carrier elements should be used, and flights over enemy-held areas should be planned to exploit the low- and slow-flying characteristics of Army aircraft as a primary means of avoiding enemy counteraction.
- (2) When the distance from the departure area to the objective area is beyond the range of Army aircraft but the distance from forward battle areas is within their range capabilities, the procedure below will normally be followed. Aircraft will be serviced and fitted in the departure area. Prior

arrangements will be made for servicing by forward areas. Aircraft will then be flown from the departure area on a planned schedule, reservice in the forward areas, and depart over planned routes to the objective area. This technique may be varied; e.g., employment of naval vessels as refueling bases or for transport on one leg of the trip.

- (3) Although requiring flight over enemy-held terrain, the above methods make the aircraft available for use in the airhead at the earliest possible time. To obtain maximum protection by friendly tactical aviation while crossing hostile positions, and to avoid flight over enemy air defense positions, a detailed flight plan is prepared and coordinated with the headquarters controlling the entire airborne operation. Such a flight plan specifies the exact route to be followed from the departure airfield to the airhead; it includes altitudes and speeds to be flown over each leg of the trip and the times of departure and arrival for each flight element. The plan may be drawn to list specific times (if they can be determined in advance) or may be prepared in terms of an H-hour to be announced. Movement of organic and attached aircraft to the objective area under cover of darkness should be given consideration in all situations.

c. Movement by Cargo Aircraft. When none of the above methods is practicable because of the extreme range to the objective area, Army aircraft can be disassembled (app. XV) for transport by troop carrier aircraft. Disassembly for transport and reassembly for use in the objective area (of some Army aircraft) is reasonably simple and can be accomplished without significant modification of tactical plans (table XXI). For other aircraft the complexity of the reassembly process in the objective areas makes their availability when needed questionable. This restriction applies particularly to the larger rotary wing aircraft, where lack of headspace in the transport aircraft requires striking of the rotor mast and disassembly of the fuselage. In the airborne division, significant lift capability is obtained by the presence of 20 light transport or utility rotary wing aircraft. Disassembly of those machines to accomplish movement will deprive the division of their services in any assault mission of short duration. Current developments of in-flight refueling techniques and auxiliary fuel cells for extension of range offer more feasible solutions to the movement of large aircraft.

d. Overland or Overwater Transportation. If no other means is available or the aircraft will not be needed in initial operations phases, Army aircraft may be disassembled and moved by motor vehicle with the followup or rear echelons overland. In combined airborne-amphibious operations, the aircraft may be transported by

ship during the buildup and consolidation phase (par. 234 and ch. 6). Transportation with the land or sea tail deprives the unit commander of the aircraft for considerable time and should be used only when mandatory.

225. Landing Areas

a. Initially, landing zones and landing sites in the airhead are selected from aerial photographs, maps, and aerial reconnaissance of the area. Army assault teams or Air Force combat control teams reconnoiter proposed landing zones and landing sites, and, if necessary, recommend alternate locations.

b. The terrain selected for landing or drop areas is relatively flat and free of obstacles. Obstacles that would interfere with landing or air navigation above a minimum altitude and that would normally be invisible to the aviator are removed or appropriately marked.

c. Landing and drop areas are appropriately marked with visual aids (panels, smoke, etc.) by the identification party of the pathfinder unit.

d. For a detailed discussion of the selection, preparation, and operation of landing or drop zones and landing or drop sites, see FM 57-20 and FM 57-35.

e. In the initial phases of an airborne operation, local security will be a prime consideration in selecting landing zones and landing sites.

226. Navigation

It may be necessary to equip pathfinder units with radio equipment which is capable of netting with that normally installed in Army aircraft. Usually, specific terrain objectives can be identified visually by the activity within the airhead. The selected landing zone(s) or landing site(s) is/are identified by smoke, panels, and flags displayed by pathfinder units (FM 57-35). More reliance may have to be placed on dead reckoning or homing devices if easily identifiable points on the ground are lacking or widely separated, as in desert, arctic, or jungle areas.

227. Communications

The pathfinder team has voice communication radios for establishing ground-to-ground or ground-to-air communication nets. Communications are no more difficult than in normal operations and should present no special problems except that abnormal damage and loss of equipment should be anticipated and additional equipment brought in to insure keeping continual operation.

228. Maintenance

All anticipated maintenance should be performed in advance of the operation. When possible, echelons of maintenance personnel are moved into the objective area during the conduct of operations. Spare parts and supplies must be provided in quantities which will assure continued operation of the aircraft until the situation permits establishment of adequate supply methods for the force as a whole. Conservation of all parts and supplies, particularly fuel, is essential.

229. Control

Normally, when the division operates in task force formation, elements of the division aviation company are placed under operational control of task forces. Task force commanders have the widest possible latitude in the use of these attached aviation elements. Higher headquarters rarely attempt to schedule operations within the force as a whole until the situation becomes relatively stable.

Section III. AMPHIBIOUS OPERATIONS

230. General

An amphibious operation, designed to land on or to withdraw forces from a hostile shore, is conducted by joint naval and ground forces. A distinguishing characteristic of this type operation is its joint action since it brings together forces which were primarily organized, trained, and equipped for functions other than joint operations. Amphibious operations may integrate virtually all types of land forces, weapons, ships, watercraft, and aircraft in a coordinated military effort against a hostile shore. Such operations require extensive air participation and landing by helicopterborne troops, and may require landings by airborne troops. Detailed discussions of amphibious operations are contained in FM 100-5 and the FM 60-series.

231. Employment of Army Aviation

a. New and improved aircraft types will have a major effect on amphibious operations. As improved types and increased quantities become available, there will be an increase in the size of the helicopterborne assault and a corresponding decrease in the size of the waterborne assault. Eventually it may be possible to eliminate the waterborne assault entirely and to utilize landing ships, craft, and vehicles only for the landing of very heavy combat and administrative support units, equipment, and bulk supplies after the initial assault has taken place.

b. In the meantime, current types of Army rotary wing aircraft afford a tremendous advantage in conducting amphibious operations.

No longer is the landing force entirely restricted in operations by the availability of suitable landing beaches. To a limited but significant degree, the initial assault can be launched without dependence upon beaches. The problem of the defender is compounded by the speed, mobility, and flexibility of helicopterborne forces combined with a nuclear preparation. Helicopterborne forces, even of limited size, provide the commander greater mobility and flexibility. Employment of the helicopterborne assault in conjunction with the waterborne assault permits a faster ship-to-shore movement, simultaneous commitment of a greater share of the landing force, and reduced concentration on the beaches.

c. The advantages of employing rotary wing aircraft to deliver a portion of the assault force are not without costs. In the landing area the control of forces operating simultaneously on land, on sea, and in the air becomes more difficult. The coordination of fires is more complex because of additional coordination and restrictive measures. The problem of coordinating air support operations with rotary wing operations is introduced.

232. Tactical Organization and Command

Command and control over the helicopterborne unit(s) and over rotary wing units to be employed in an amphibious operation should be vested in a single commander. This can be accomplished in several ways: the rotary wing unit in direct support of the helicopterborne unit; the rotary wing unit under the operational control of the helicopterborne unit commander; the rotary wing unit attached to the helicopterborne unit; or a rotary wing assault force formed. Unless the operations of several helicopterborne forces require additional coordination or the size of the committed forces dictates otherwise, direct support or operational control are the preferred means for achieving unity of effort.

233. Details of Rotary Wing Employment in Amphibious Operations

The details of planning rotary wing employment in amphibious operations (selection of landing zones, selection of routes of approach and retirement, linkup with waterborne assault forces, and the ship-to-shore planning documents required) are contained in FM 57-35, "Army Transport Aviation Combat Operations."

234. Transporting and Launching of Aircraft

a. Specially designed or converted aircraft carriers are preferred for transporting, launching, and serving as a base of operations for Army aircraft taking part in amphibious operations. When these type ships are not available in the required quantity, unconverted

carriers can be utilized. In the absence of carriers, vessels of the LST type may be converted into improvised carriers.

b. Those aircraft not to be used until suitable landing fields and/or landing zones have been established ashore may be disassembled and stowed aboard a vessel. To facilitate unloading in the objective area, these aircraft may be loaded in trucks (app. XV) and reassembled on shore. When aircraft are loaded in trucks or stowed in holds, space requirements must be calculated closely.

235. Navigation

Because radio silence is normally lifted within initiation of the preparation before the amphibious assault, radio aids to navigation are normally available to Army aircraft taking part in amphibious operations.

236. Communications

The principal communication difficulties in amphibious operations are those inherent in the heavy radio traffic of a large number of units operating in coordinated effort. Aviators and observers must be completely briefed on frequencies and call signs, particularly those of naval elements with which they will be working.

237. Maintenance

a. The problems of maintenance and supply begin before the landing force embarks. To determine what maintenance will be required during the operation and what supplies can be carried, the following must be considered:

- (1) Mission of the aviation unit.
- (2) Type of shipping in which aircraft are to be transported.
- (3) Location of initial landing fields or zones ashore, and their expected availability.

b. As the operation progresses, maintenance is hindered by the displacement of maintenance operations from carriers at sea to landing fields ashore.

Section IV. JUNGLE OPERATIONS

238. General

For more detailed discussion of jungle operations, see FM 72-20 and FM 100-5.

239. Landing Area Construction

a. *General.* Large swamp areas and areas covered by heavy foliage limit the number of landing sites.

b. *Landing Fields.* Construction of landing fields for Army aircraft in jungle areas requires considerable time and heavy equipment.

Frequent rains generally necessitate surfacing landing fields with mats, crushed rock, or coral. In areas where rivers and lakes are numerous and of sufficient size, waterways can be used in lieu of landing fields (par. 314) by Army aircraft equipped with floats or amphibious gear.

c. Landing Sites. Construction of rotary wing landing sites will ordinarily be performed with handtools and explosives. Such construction, being difficult and time consuming, can be simplified by using a portion of the felled trees to construct a platform rather than completely clearing the ground.

d. Density Altitude (theoretical altitude of a point determined by the altitude at which its air density would place it in the standard atmosphere). Density altitude during extremely hot weather reduces aircraft performance; thus larger landing areas may be required.

e. Construction Responsibility. Landing area construction is the responsibility of the engineers.

f. Unit Displacements. Jungle unit displacements are usually of short distances. Passage is so difficult that the problem confronting the commander is not *how far* the unit displaces but *how long it will take*. Hence, aviation units do not displace in these areas as frequently as in less difficult terrain.

g. Security. Infiltration tactics are used extensively in jungle areas, and local security is of prime importance when considering airfield location and organization.

240. Navigation

Aviators should be given exact bearings and distances from easily recognized terrain features to airfields and landing sites if such sites are difficult to locate. River bends, hilltops, and other salient terrain features can be used for point-to-point navigation. Flying time—distance from features to the landing area or area of operations—is usually the easiest method of navigation. In addition, observers and aviators must learn to recognize terrain characteristics not ordinarily used for orientation, such as variations in color, density, or types of vegetation.

241. Missions

a. Dense jungle prevents practical utilization of common ground-marking devices such as panels or smoke grenades. Ground units, therefore, should make use of pyrotechnic signals to gain the attention of aviators. After location of the ground party, the aviator can drop foil strips or colored parachutes to mark the position. Dense, high vegetation makes it extremely difficult to detect ground positions or to locate units. Smoke grenades, panels, and other common marking devices may be of little or no use. Pyrotechnics that may

be projected are effective for ground parties in signaling their position to aircraft. This device will penetrate the canopy of vegetation in most instances and can be readily seen from the air. Once ground units are located, aircraft can drop foil strips or colored parachutes onto the tops of trees to mark the position.

b. Uniformity of dense vegetation requires skilled aerial observers thoroughly trained in ground jungle operations. Conduct of artillery fire may be difficult even with highly trained observers when the thick vegetation obscures shellbursts. In such cases, the use of white phosphorous smoke shell for adjustment is recommended. Key personnel of supported ground units should receive observer and aviation support training.

c. Army aircraft can be employed extensively for troop movements, resupply, evacuation, wire laying, and other transportation and communication missions not readily within the capabilities of ground (jungle) means.

242. Communications

a. Radio is the primary means of air-ground communications. The use of panels, message drop and pickup, and other means of air-to-ground communication is generally unsatisfactory.

b. Aircraft can frequently assist in ground communications by laying wire (pars. 28-29) and acting as radio relay stations (pars. 30-32).

243. Aerial Resupply

If terrain and availability of landing sites permit, resupply by rotary wing aircraft is more efficient than drops from fixed wing aircraft. Supplies dropped by parachute may hang in the canopy of trees where a large percentage cannot be recovered by ground parties even if located. Free drop is most effective when the drop can be made into a river, stream, or other body of water and the ground party can take immediate action to recover the supplies.

244. Survival and Jungle Training

a. All aviators should receive jungle survival training to increase survival chances if forced down and to increase their confidence in coping with jungle conditions or with emergencies which supported units therein may face.

b. Personnel unfamiliar with the jungle may tend to panic in its strange environment. Survival training lessens the amount of fatigue and strain experienced by pilots engaged in jungle operations. Suitable survival gear must be provided in all aircraft: survival kits that double as seat cushions and buckle to the parachute harness are

available. Aviators must be familiar with the contents of the kits and understand their use.

245. Weather

Jungle operations suffer during the rainy season. Rainstorms often are violent, moving with fair rapidity; these movements, predictable, usually follow a schedule that varies little from day to day. Typical cloud formations, cumulus and cumulonimbus, often can be circumnavigated. Alternate fields must be selected for all missions, or sufficient fuel must be available to outlast storms moving across airfields. Generally smooth flying conditions and excellent visibility prevail between storms. Dry seasons are characterized by poor visibility, high winds, and turbulence.

246. Aircraft Maintenance

All equipment directly exposed to the weather is adversely affected by the climate and requires additional maintenance. Electronic equipment must be operated or turned on for appreciable periods daily to prevent damage from fungus.

Section V. MOUNTAIN OPERATIONS

247. General

A more detailed discussion of mountain operations is given in FM 31-72.

248. Mountain Weather

Weather in mountains is variable, both in summer and winter, and day and night temperatures vary markedly. Sudden and localized violent rainstorms, snowstorms, and fog are common. Atmospheric turbulence and strong air currents make flying hazardous.

249. Landing Areas

Aside from difficulties imposed by density altitude, mountainous areas pose no particular problem in selection of rotary wing landing sites. The general lack of clear and level terrain does, however, provide limited choice in selection of landing fields; hence landing fields may often be located at a considerable distance from the supported unit.

250. Navigation

With adequate maps or photographs, mountain navigation by pilotage is not difficult except when fog, snow, or rain restricts visibility. Identification of checkpoints may become difficult when flying circuitous routes to avoid impassable peaks and ranges; a constant check of position is required to avoid mistakes. In seeking

routes around obstacles, care must be exercised to avoid entering blind compartments.

251. Missions

Army Aviation performs the following typical missions on mountainous areas:

- a.* Reconnoitering routes and positions.
- b.* Wire laying.
- c.* Courier and liaison.
- d.* Message drop and pickup.
- e.* Radio relay (pars. 30-32).
- f.* Special missions, especially by rotary wing units, to and from points inaccessible to ground transportation.

252. Communications

a. Radio communication may be difficult because of intervening ground features. To maintain communication with the supported unit, aircraft may have to remain in the vicinity of the supported unit, or additional aircraft may have to be employed as radio relay stations.

b. Because landing areas may be at considerable distance from the supported unit, it is particularly important that wire communication be established with the supported unit's command post to facilitate briefing and interrogation of aviation personnel.

253. Aircraft Maintenance

Difficult routes of communication often limit supply, and major aircraft maintenance may have to be accomplished at bases in rear areas where the necessary parts and equipment are available.

Section VI. DESERT OPERATIONS

254. General

A more detailed discussion of desert operations is given in FM 31-25.

255. Landing Fields (Sites)

a. In most desert areas, the sandy or pebbly ground surface permits selection of landing fields (sites) almost at will, including location in the immediate vicinity of the supported unit's command post when not jeopardizing CP (command post) security. In desert regions containing large boulder-strewn areas, landing fields (sites) should be carefully marked. Certain hard-packed areas formed by the evaporation of accumulated water will become unusable in the event of rain.

b. Desert terrain provides scant concealment of camouflage for aircraft and equipment. Aircraft can be easily spotted by enemy fighters and successful evasive action is more difficult due to the lack of protecting terrain features. Improvements to landing fields (sites) facilitating location by enemy air observation should be avoided. Aircraft, vehicles, and equipment must be widely dispersed and their outlines broken by the use of camouflage.

c. The wide deployment of units, open flanks, and active enemy raiding parties make the local security of landing fields (sites) a prime consideration in their selection.

256. Navigation

Navigation above the desert is complicated by the relatively long distances between installations and by the general scarcity of terrain features or other reference points on the ground. Sketches prepared by aviation personnel should supplement maps and photographs. These sketches should indicate various shades of sand, the general pattern of sand dunes and drifts, salt or mud flats, wreckage, craters, and other features which can be readily identified from the air.

257. Missions

Missions most frequently assigned to Army Aviation in desert operations are the conduct of artillery fire; security surveillance; courier service; and communication and supply for widely dispersed command, reconnaissance, and security groups.

258. Communications

The range of radio communication in flat desert areas is appreciably greater than in other types of terrain.

259. Aircraft Maintenance

a. The chief maintenance problems are caused by sand and dust. Aircraft create large clouds of sand and dust when landing and taking off. This sand and dust is drawn into running engines and acts as abrasives on internal parts. Transparent materials such as plastic windows of aircraft are pitted by blowing sand, with a resultant loss of visibility. Sand also adheres to lubricated parts, causing excessive wear.

b. To minimize damage caused by dust and sand, landings and takeoffs should be made near mooring points to reduce taxiing distances. All openings should be covered as soon as the engine is stopped. Maintenance sites should be selected on the hardest ground available. Engines should be operated at low speed over loose sand. Runup stands for engine test should be constructed in areas free of sand. If such areas are not available, engines should be tested over

pits filled with rocks or over areas covered with tarpaulins. A marked increase in oil consumption will indicate internal wear of parts; the engine must be changed promptly to avoid wear beyond the point of economical repair.

c. Sudden and violent winds are common in desert regions, and aircraft should be moored in chock holes to reduce the angle of attack of the wings. Spoilers, placed on the wings (par. 391), will further reduce lift.

Section VII. OPERATIONS IN SNOW AND EXTREME COLD

260. General

A discussion of operations in snow and extreme cold is given in FM 31-70 and FM 31-71.

261. Landing Fields (Sites)

a. In deep snow, surfaces must be smoothed and packed by dragging or by the use of tracked vehicles. With a small amount of pioneer work, hard wind-packed areas can be made usable for aircraft equipped with skis. Frozen lakes and rivers make excellent landing fields for rotary wing aircraft and for fixed wing aircraft equipped with skis.

b. Deep, soft snow requires longer runways for takeoffs and landings. The deeper the skis sink into the snow, the longer the ground run required to take off.

c. Aircraft equipped with conventional three-point landing gear generally operate more satisfactorily on skis than those equipped with tricycle gear. In the latter the nose of the ski tends to dig into the snow.

262. Navigation

a. Although adequate maps of certain parts of Canada and Alaska are available, particularly along airways, most arctic regions are not accurately mapped. The coastline, fjords, and river mouths are generally reliable, but mountains are inaccurate in location, shape, and altitude. Location of rivers and lakes are generally inaccurate, particularly in the inland areas. Most of the terrain in the tundra and arctic waste regions is void of distinct landmarks, making pilotage extremely difficult.

b. The magnetic compass is often unreliable at higher latitudes, due to the many and rapidly changing magnetic irregularities and to rapid changes in variation caused by the convergence of the meridians at the pole. Consequently, special navigational aids may be required. For relatively close-in operations, a ground radar set with standard radio equipment can be used to provide a homing

device for aircraft. A standard portable radio beam or broadcasting station, in conjunction with directional antennas on the aircraft, can also provide a reliable homing device. When the situation precludes the use of radio, the pilot must primarily navigate by pilotage from photographs or sketches showing prominent terrain features.

263. Missions

a. In observation missions, ground movement can be detected at great distances because of the long shadows cast in daylight. Tracks created by enemy movement can be detected except when obscured by drifting snow. Ice fog which forms over vehicles, troops, and firing weapons is plainly visible. When the enemy is dug in or in bivouac, he may be concealed quickly by new-fallen snow.

b. Artillery shells, even those with superquick fuzes, tend to bury themselves in deep snow which smothers the bursts. The use of colored smoke shell during adjustment is often necessary under such circumstances.

c. Since snow offers a good background for the observation of activity and installations not adequately camouflaged, most observation missions can be performed effectively at night with a minimum of light.

d. Army Aviation can assist in many activities which ground troops find difficult in the arctic regions, such as wire laying, transportation of personnel, supply, and evacuation. Aviation units can support units which could not be supported by surface transportation.

e. Army Aviation offers a satisfactory means of flank reconnaissance and early detection of enemy attacks.

264. Communications

a. Radio communications may be hindered or disrupted by electrical disturbances (aurora) in the arctic regions. However, such disturbances are temporary, and radio communication is generally good. Homing devices (par. 279a(2)) are rarely disturbed. The extremely low temperatures adversely affect batteries; generating equipment must be kept in excellent condition. Prewarming batteries increases their output.

b. Other means of communication can be employed without difficulty. Army aircraft are particularly useful in the pickup and delivery of messages.

265. Aircraft Maintenance

a. Problems of aircraft maintenance stem directly from the low temperatures. Special precautions and equipment are necessary to

insure efficient aircraft operation. Shelter must be provided for personnel performing the maintenance.

b. Even under emergency conditions, engines should not be started at temperatures of 20° F. and below without use of an electrical power unit for starting assistance. External heat application against the engine accessory case, carburetor induction system, oil sump, and battery simplifies starting. A portable, combustion-type heater incorporating a blower and flexible hoses is standard equipment for such preheating. This equipment may also be employed to heat portions of the aircraft for maintenance work without gloves. When temperatures are habitually below +10° F., aircraft batteries not in use must be removed and stored in a warm place to maintain their charge.

c. Thickening of oils at low temperatures presents problems in engine operation and in starting. An aid in extreme cold is the installation of standard winterization equipment which includes baffles on oil coolers to maintain proper temperatures. Oil dilution units may also be installed, although draining the oil from engines at the end of the day's operations and heating it before use is normally satisfactory. The propeller pitch control should be set in full decrease rpm position when stopping an engine equipped with a controllable pitch propeller actuated by engine oil pressure. In all cases, the proper technical order reference should be consulted.

d. Carburetor heat is generally used to raise an air inlet temperature of the carburetor during operation. This increases the rate of fuel vaporization and minimizes the possibility of carburetor ice. Carburetor heat should be used judiciously, within the operating limitations of the applicable operating instructions handbook of the particular aircraft type.

e. Frost and ice on wing surfaces destroy aerodynamic efficiency; takeoff must not be attempted until frost and ice are removed.

f. Wheels should be kept on dry surfaces or on blocks to prevent freezing to the ground.

g. Mooring of aircraft is accomplished by placing the ends of mooring ropes on the ground, covering with snow, and wetting the snow. This freezes the ropes in the ground.

Section VIII. OPERATIONS AGAINST GUERILLA FORCES

266. General

For a detailed discussion of operations against guerilla forces, see FM 31-20.

267. Missions

In operations against guerilla forces, Army Aviation performs the same missions as in other offensive operations. Because of enemy infiltration, however, certain of these missions increase in importance.

a. Security reconnaissance missions are as necessary in rear areas as in front and flank areas.

b. Route reconnaissance for columns moving in rear areas is advisable.

c. Commanders and liaison officers should depend more upon air transportation between units than in normal offensive operations.

d. Local logistical missions such as supply and evacuation are more frequent than normal. Rotary wing aircraft may be used to transport units countering enemy operations behind friendly lines.

e. The use of Army Aviation to transport airmobile task forces permits a significant reduction in the size of reserve forces required to counter and eliminate guerilla threats.

268. Landing Fields (Sites)

The operations of guerilla forces and an unfriendly civilian personnel seriously increase the problems of local security of airfields. Aviation units will require additional security elements if the airfield is distant from the perimeter defense of ground units. The use of common airfields may be required for defense purposes. Aircraft may have to operate from airstrips in the vicinity of the unit command post during daylight and move to the rear to a common airfield at night.

269. Communications

Since guerilla forces will usually cut all wire communication lines encountered, good radio communication facilities between airfields and command posts are essential.

270. Precautions

Constant alert must be maintained for devices constructed by guerilla forces or unfriendly civilians to wreck low-flying or landing aircraft; for example, wire stretched between trees.

Section IX. OPERATIONS IN SUPPORT OF GUERRILLA FORCES

271. General

For a discussion of operations in support of guerilla forces, see FM 31-21.

272. Missions

a. For operations in support of guerilla forces, the flight characteristics and inconspicuous size of Army aircraft make them suitable for use in a wide variety of missions, including the following:

- (1) Carrying messages and other written material back and forth between friendly troops and guerilla forces.
- (2) Transporting individuals as guerilla activities require.
- (3) Transporting limited amounts of supplies and equipment to guerilla forces.
- (4) Evacuation of guerilla casualties.
- (5) Assisting in the recovery of evaders.

b. Guerilla forces can be transported by Army aircraft to disrupt enemy lines of communication, to execute demolitions, and to perform general harassment activities.

273. Precautions

The following principles must be observed in utilizing Army aircraft in guerilla activities:

a. The pilot of the aircraft must be thoroughly briefed as to the location of the area in which he will land. He must know the location of all known enemy installations and positions near which he may have to pass.

b. Whenever practicable, a system of prearranged messages for communication with the guerillas on each specific mission must be established to provide maximum security in communication.

c. Arrangements must be made to clearly identify the landing area to the aviator to eliminate landing in the wrong area. In addition, the area should be marked to indicate its usable limits and the wind direction (fig. 13), so that the aviator may land without circling the field or otherwise revealing its location to possible enemy observers.

d. Any landing area selected must be as distant from enemy forces as the situation will permit.

e. Because the enemy probably will discover any landing area being used, locations must be changed frequently. If it is suspected that the enemy has learned even the approximate location of the landing area, another one should be chosen.

f. For mutual protection, identification signals must be used both by the aviator and personnel on the ground.

g. To avoid the fire of friendly units along the flight path, they must be informed of the proposed aircraft passage.

h. Wherever possible, flights across the lines should be made under cover of darkness. If the aircraft is suitably camouflaged with dark paint, the enemy will have difficulty observing it except by

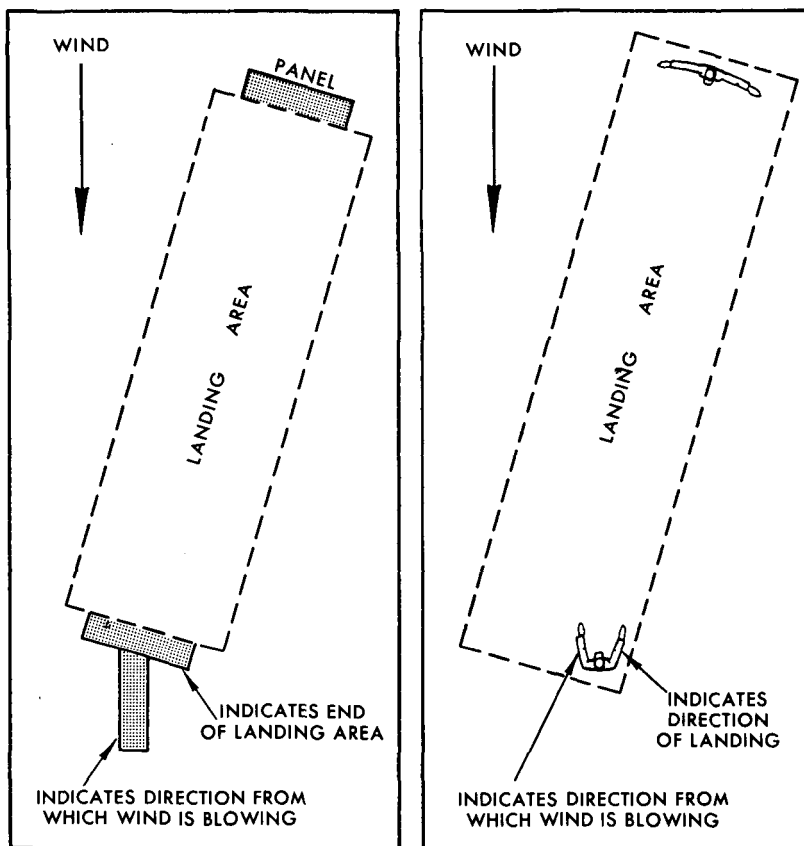


Figure 13. Usable limits and wind direction.

electronic means. Missions which cannot be completed in one night should normally not be undertaken unless the situation indicates that the aircraft can remain safely on the ground in enemy territory during the following day and return to friendly lines the next night.

274. Flight Paths and Altitudes

a. For night guerilla operations, the aircraft should be flown at the highest practicable altitude to lessen the possibility of detection. Noise can be further reduced by cruising at minimum power settings. Descent and approach should be made with minimum power.

b. If the mission must be flown during daylight, it can be flown most safely at minimum altitude just high enough to clear obstacles in the flight path. The aircraft should be flown below treetop level, along stream lines, in ravines, or wherever concealment can be obtained. Operation at minimum altitude also offers maximum protection against observation by hostile fighter aircraft.

c. Whether flying during daylight or darkness, the flight path should be circuitous. A flight path direct to the field of intended landing or to the area where supplies are to be dropped is dangerous because the enemy can locate the destination airfield and/or alert his units along the flight path to take the aircraft under fire on the return trip.

CHAPTER 14

COMMUNICATIONS AND AIR TRAFFIC CONTROL

Section I. COMMUNICATIONS

275. General

a. Tactically employed Army aircraft are radio equipped for communication with infantry, armor, and artillery elements, and with aircraft of other services. Radio communication with supported units is accomplished with FM-VHF radio. Radio communication with supporting Air Force or Navy aircraft is accomplished with AM-UHF radio equipment in Army aircraft.

b. Most aircraft radio equipment is line-of-sight, with reception and transmission over greater distances made possible by higher altitude as compared to ground level reception and transmission. This greater range, however, makes hostile monitoring and electronic countermeasures more likely. It also creates the problem of mutual interference with distant ground unit radios operating on the same frequencies; hence, assigned radio frequencies for aircraft should be spaced to minimize this interference.

c. Air-ground panels and message drop and pickup may be substituted for radio in air-ground communications when enemy electronic warfare (EW) precludes the use of the latter.

276. Orders and Instructions Affecting Communication

a. Signal Operation Instructions (SOI) are a type of combat order issued by major commands for the technical control and coordination of communication within a command. They include items subject to frequent change, such as authentication systems, operations and map codes, radio call signs and frequencies, telephone directory, teletypewriter call signs, visual signals, sound signals, and sunrise and sunset tables.

b. The Standing Signal Instructions (SSI) contain items of operational data not subject to frequent change and instructions for the use of the SOI. It is used to amplify and supplement signal operation instructions.

c. Standing Operating Procedure (SOP) pertaining to communication is prepared by aviation units based on higher echelon SOP.

Standing Operating Procedure is particularly applicable to communication procedures since many of these procedures are similar in nature in most tactical operations.

d. Paragraph 5 of an operations order contains orders and instructions relative to communication and command posts. It also contains applicable instructions which may include a reference to the signal annex or index to SOI in effect, communication restrictions, command post location, and special signal instructions. A signal annex to the operations orders may be used to amplify instructions contained in the body of the order.

e. Various JANAP's (Joint Army-Navy-Air Force Publication) and ACP's (Allied Communication Publication) contain instructions applicable to Army Aviation operations including common call signs, emergency call signs, recognition and identification instructions, visual signals, brevity codes, and various communication procedures concerning air navigation. Current status of these publications is contained in JANAP 201-series.

277. Duties of Aviation Unit Communications Officer

An aviation unit communications officer's principal duties include—

a. Advising the commander on communication matters and making plans and recommendations for establishing the communication system.

b. Supervising the installation, operation, and maintenance of the communication system.

c. Coordinating communication with higher, adjacent, supported, and attached units.

d. Coordinating communication support requirements with the supporting signal officer; preparing plans for displacement or extension of the existing unit communications system.

e. Supervising the care of signal equipment to include second echelon maintenance.

f. Supervising the maintenance of communication security, including the employment of codes and authentication systems.

g. Supervising the training of communication personnel and others designated by the commander.

h. Supervising procurement and distribution of authorized signal equipment and supplies.

i. Arranging for distribution of required Signal Operation Instructions (SOI) and Standing Signal Instructions (SSI) items from higher headquarters.

j. Preparing the unit communication Standing Operating Procedure (SOP).

k. Assisting in selecting the exact location for communication and navigation installations within the unit installations.

278. Ground-to-Ground Communications

a. Wire.

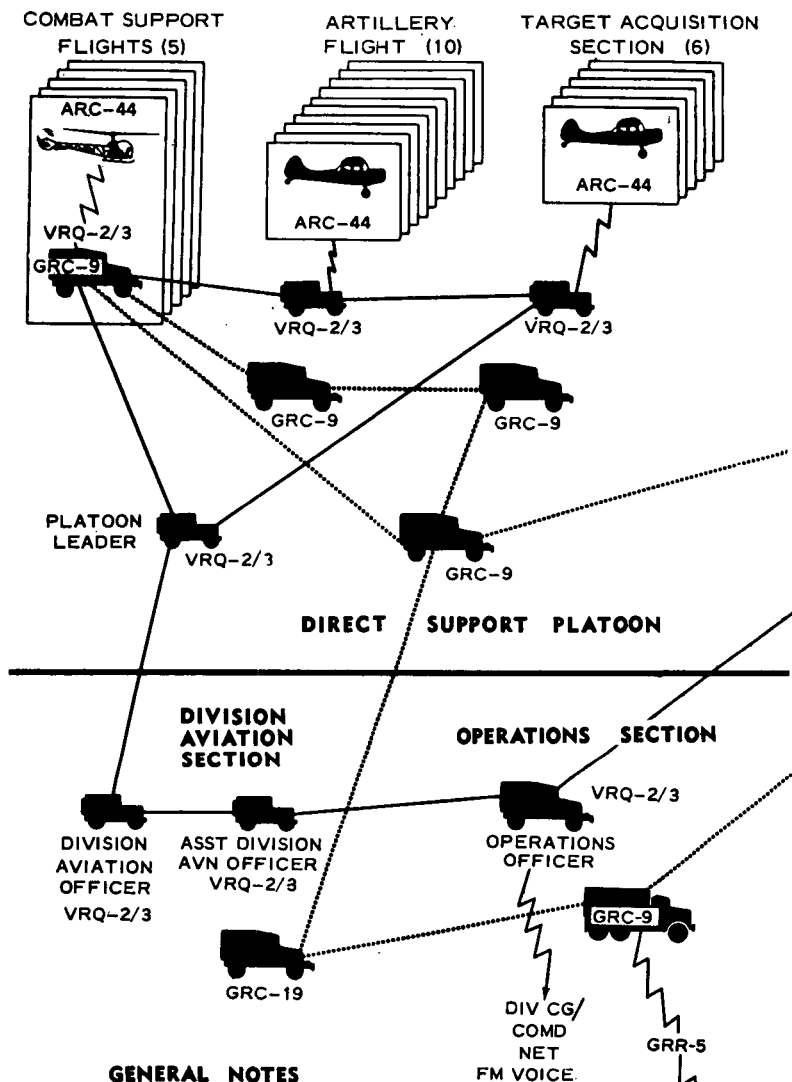
- (1) Wire or wire substitute circuits from the aviation unit to higher headquarters and supported unit(s) will be provided through the Area Communications System or existing unit communication facilities. Aviation company personnel will install local wire circuits to unit installations.
- (2) Overhead lines will be placed in locations and in a manner assuring minimum hazard to aircraft operations in the area. Any wire across airfield approaches must be laid on the ground.
- (3) Wire communication between the division base field and the battle group flights supporting divisional elements is effected through existing nets.
- (4) Communications from the division forward flight strip to division trains and to general support flight elements based in the division rear areas will be provided by the Area Communications System on a direct or common-user basis.
- (5) Wire communications between the aviation unit flight operations section and the Flight Operations Center (FOC) will be provided through the area communications system.

b. Radio. Radio communications equipment (fig. 14) of the division aviation company provides combat support flights with radio facilities to communicate with supported and parent units. The aviation company operates in/or monitors the following divisional nets:

- (1) Division warning broadcast net (AM Voice).
- (2) Division intelligence net (AM-RT).
- (3) Division administrative/logistic net (AM-RT).
- (4) Division command/operations net (AM-RTT).
- (5) FOC net (AM Voice).
- (6) Division command net (FM Voice).

Note. Extensive use of radios in parked aircraft for ground stations limits the life of the battery and considerable engine runup is required in recharging batteries subjected to such use.

c. Messengers. Early liaison between the aviation unit and the supported unit expedites installation of communications facilities and assures proper coordination between the units. If flight groups land to occupy airfields before wire communications or proper defense arrangements have been established, messengers should be promptly dispatched to the supported unit to effect liaison. Necessary messengers will be included in the advance party occupying an airfield. Messengers may also be employed for liaison with adjacent units in planning and coordinating the local defense plan. Dis-



GENERAL NOTES

NOTE 1. THE FREQUENCIES ALLOCATED FOR THE CO OPN NET SHOULD BE IN THE FREQ. RANGE OF 37-37.9 MEGACYCLES.

NOTE 2. VRQ-2/3-1/2 OF AN AN/VRQ-2 COMBINED WITH 1/2 OF AN AN/VRQ-3 TO PROVIDE TWO BAND COVERAGE.

Figure 14. Typical radio nets, division aviation company.

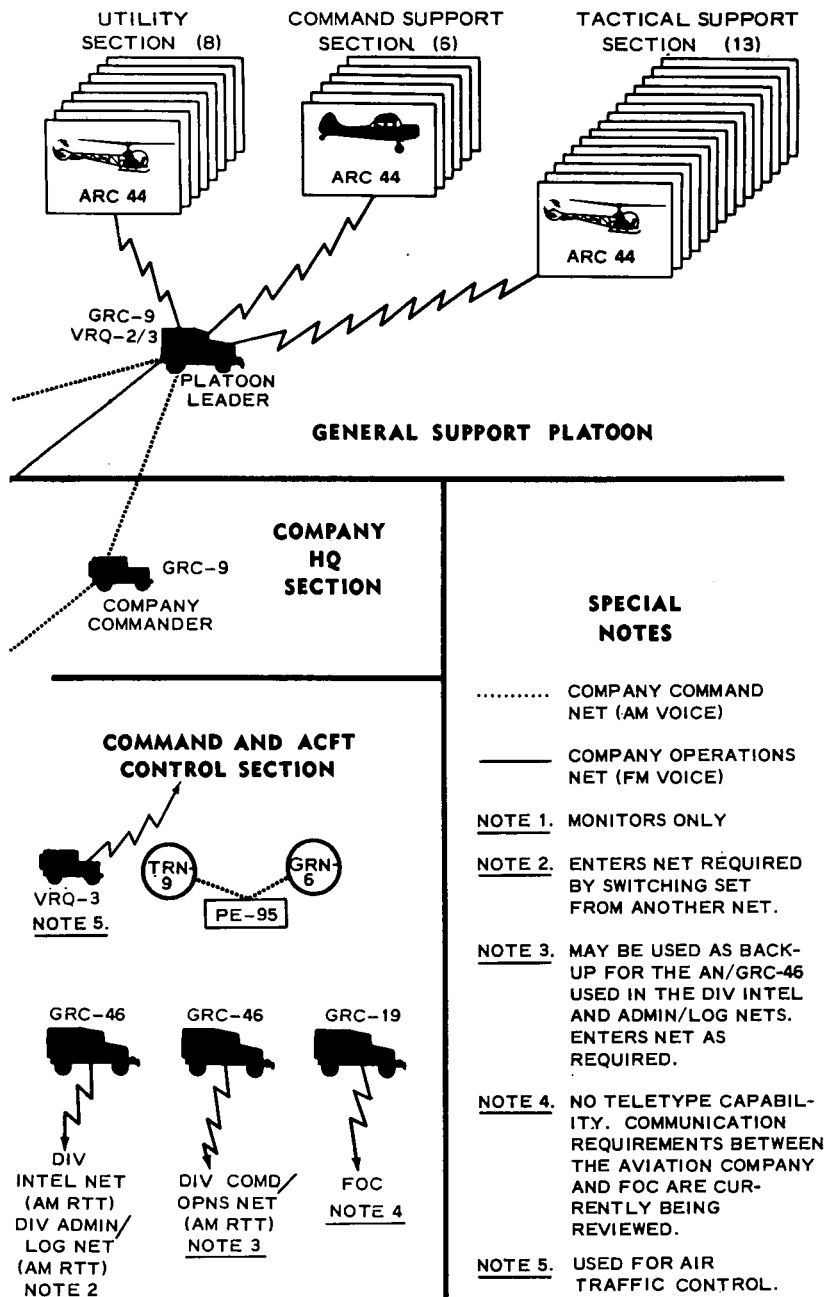


Figure 14.—Continued.

mounted messengers or guides can further be employed to direct radio and/or wire teams and other friendly personnel to the airfield.

- (1) *Foot messengers.* Foot messengers are used for short-distance communication within or between small tactical units or between elements of an installation such as a command post or an aviation installation. They may be used in terrain impassable to motor vehicles.
- (2) *Motor messengers.* Motor messengers are used for greater distances such as between command posts. They are also used to a large extent for communication between an airstrip and the supported unit command post.

d. Visual. Individual aviation units are responsible for properly marking or otherwise identifying airfield location and routes within the airfield installation area. Ground route paths and approaches to landing sites should be marked to prevent entrance to, or crossing of runways by vehicles and personnel. Visual aids must also be provided for directional assistance during blackout and night taxiing of aircraft.

279. Air-to-Ground Communications

a. Frequency Modulation (FM). Most air-to-ground radio communications with the supported unit are conducted with radio set AN/ARC-44 in the aircraft and tactical FM radio equipment on the ground. Aircraft in flight at low altitudes and at great range from the ground station with which communication is planned may experience line-of-sight restriction common to the very high frequency (VHF) band in which this tactical FM equipment operates. In this situation, aircraft at higher altitudes can relay radio messages to those at lower altitudes, thereby assuring clear receipt of warnings of approaching hostile aircraft, proximity-fuzed artillery fire, or atomic projectiles. A system of transmission of warnings by radio will be provided in the aviation unit's standing operating procedure.

- (1) Most FM transmitters operating in the armor, artillery, or infantry radiofrequency band can be utilized by Army aircraft as a source radio wave on which to orient the FM homing device found on the AN/ARC-44.
- (2) The FM homing capability can be employed to expedite finding locations for aeromedical evacuations on the battlefield or aerial pickup of troops in enemy rear areas.

b. Amplitude Modulation (AM). This equipment, operating in the Ultra High Frequency (UHF) band, is used primarily for air-ground communications with flight operations centers, airfield control towers, and other air traffic control communications facilities and for air-to-air communications with aircraft of the other military services. It can also be employed as a secondary means of air-to-air

communication between Army aircraft and air-to-ground tactical communications with Army units having UHF communication capabilities. Air-to-ground communications may be established with survivors employing UHF radio set AN/URC-4. FM and AM frequencies for air-to-ground communication will be specified in appropriate Signal Operating Instructions (SOI).

c. Visual Communications. Visual communication used by Army Aviation elements includes pyrotechnic signals, panels, hand and arm signals, aircraft maneuvers, and light signals. Visual communications are a supplemental means suitable for transmitting prearranged messages over short distances. However, visual signals are easily misunderstood, and very susceptible to enemy interception and use. Therefore, considerable care must be exercised to prevent compromise of visual signals.

- (1) *Pyrotechnics.* Pyrotechnics, including smoke and flares, are issued in various colors. The meanings of common pyrotechnic signals are included in the SOI. Pyrotechnic signals which are pertinent to Army Aviation are established for identifying units or aircraft as friendly, marking targets, denoting aircraft distress, requesting scene-of-action radio communication, and signals denoting significant ground action (ACP 168).
- (2) *Panels.* Panels are used in air-ground communication for marking, identification, and transmission of messages. Two general types of panels are issued for communication with aircraft: Marking and identification panels which are made in bright fluorescent colors, and black and white panels which are used on light and dark backgrounds for transmitting messages. In the absence of standard signaling panels, improvised material offering good contrast to the background may be used. Panel signals are usually prearranged; however, transmission which cannot be prearranged can be made by using the code prescribed in ACP 129. In addition, standard emergency panel signals are prescribed in JANAP 131.
- (3) *Hand and arm signals.* Hand and arm signals are used in the ground handling of Army aircraft. They may also be used in rotary wing landing operations by prearrangement. Standard emergency arm signals for ground-air communication are shown on the back of most sectional aeronautical charts.
- (4) *Aircraft maneuvers.* Aircraft maneuvers, such as zooms, rocking of wings, or alternate opening and closing of throttle, are used for limited communication from air to ground. Use and meaning of such maneuvers are issued as part of

the SOI. Also, certain aircraft maneuvers are used for identification and emergency communication to ground radars.

- (5) *Light signals.* Signal lamps are used by Army Aviation elements as a means of control of local traffic in the vicinity of airfields, both in the air and on the ground. The signal lamp used is capable of transmitting red, white, or green signals and must be aimed at the recipient of the message. Standard light signals are prescribed for use in local air traffic control.

280. Air-to-Air Communication

FM radio (voice) is the primary means of air-to-air communication between Army aircraft; UHF radio (voice) is the secondary means. UHF radio (voice) is the means of air-to-air communication between Army aircraft and aircraft of the other military services. Frequencies for air-to-air communication on FM and UHF will be specified in appropriate Signal Operating Instructions (SOI).

Section II. COMMUNICATION SECURITY

281. General

Communication security measures are designed to prevent or delay unauthorized persons from gaining information of military value from communication sources. The three elements of communication security are *physical security*, *crypto security*, and *transmission security*. The maintenance of communication security is a command function. All personnel, particularly those who personally transmit radio messages, must be cognizant of communication security. The commander establishes communication security measures by stating general principles in the unit SOP, by announcing before an operation the extent to which security is to be practiced in that operation, and by making security decisions during an operation. Messages that might compromise the plans, operations, or crypto systems of other units are never transmitted in the clear.

282. Physical Security

Physical security is the physical means taken to prevent capture, loss, unauthorized access, or damage to communication material or equipment. Critical items—SOI, codes, and ciphers—are limited in distribution. A complete SOI is never taken forward of frontline battalion or battle group command posts. SOI extracts carried in Army aircraft are limited to material essential for successful operation of the aircraft and are so prepared as to be capable of ready

destruction. When SOI or crypto materials are lost or captured, the facts are reported promptly to the next higher commander. Installations being vacated are inspected for the presence of security material. Unit SOP prescribes for emergency destruction of equipment and classified documents to prevent capture and enemy use. Classified material and equipment carried in aircraft will be destroyed if the aircraft is forced down and capture is imminent. If explosive destructors are not on the equipment, destruction can be accomplished by burning the aircraft or by hand grenades.

283. Cryptographic Security

a. General. Time spent in encrypting gives a high return in security. Strict observance of cryptographic operating instructions is essential to reduce the effectiveness of enemy communications intelligence effort. The use of unauthorized systems is forbidden since most such systems are susceptible to easy solution and give the user a false sense of security. Security hazards are minimized by brevity and avoiding stereotyped phraseology. Identical messages are not sent in clear and secret text or in more than one cryptographic system. When clear text is used, landmarks that can be associated with encrypted map locations are avoided as references.

b. Cryptographic Security of Aviation Units. Aviation units use standard cryptographic systems in terrestrial radio communication as appropriate to the level of the net being used. Individual aviation units use prearranged and operation codes on internal communication nets when messages cannot be sent in the clear. Cryptographic security in all Army Aviation air-ground communication is limited to prearranged and operation codes when messages cannot be sent in the clear. A standard prearranged and/or operation code is prescribed for all aviation elements within a field army for traffic control system communication.

284. Transmission Security

a. General. Transmission security limits enemy opportunities to intercept transmissions and prevents his using the communication systems for purposes of deception. Radio is particularly susceptible to interception, position-finding, traffic analysis, and deception. A high standard of operator training and net discipline prevents divulging information to the enemy through faulty procedures. Unnecessary transmissions are eliminated. Brevity, adherence to prescribed radiotelephone procedure (JANAP 125B), and authentication systems must be employed to protect radio transmissions.

b. Authentication. The authentication system of tactical air-ground communication is either that of the major command to which the aircraft are organic or that of the unit which the aircraft is

supporting. In air traffic control communication, a standard authentication system is prescribed for all aviation within a field army.

Section III. AIR TRAFFIC CONTROL

285. General

Army air traffic control in the combat zone is established to coordinate and expedite the safe and orderly flow of Army air traffic under virtually all flight conditions, assist in air defense functions of the command, and provide in-flight assistance to Army aircraft. Air traffic control is a command responsibility. The Army Aviation officer at each level is directly responsible for the establishment and operation of the air traffic control system. The organization of this system in the combat zone parallels the command structure of the field army. It is closely integrated into the air defense system of the command to permit maximum coordination of operations.

286. Control Measures

The control measures in the Army air traffic control system are (1) those primarily for the purpose of facilitating traffic flow and (2) those primarily for the purpose of facilitating the air defense functions of the command. The former are standing measures and, in practice, are subject to little variation. The latter are subject to frequent changes or modifications dependent on current requirements of the air defense situation within a theatre of operations.

a. Many control measures which primarily facilitate traffic flow also facilitate air defense operations.

b. Control measures are established by theatre or task force commanders. They are uniform throughout the theatre (task force) and place minimum restrictions on the utilization of Army Aviation by subordinate commanders.

c. Implementation of control measures is coordinated with other services by aviation staff officers and air defense commanders.

287. Types of Traffic Control

The four general types of traffic control utilized by Army Aviation in the combat zone are *area control*, *route control*, *point-to-point control*, and *airfield control*.

a. Area Control. Area control is typical forward of division base airfields during night and instrument flight conditions (IFC). The basic area is that area bounded by the corps lateral boundaries and forward of division base airfields. The only control prescribed in this area is the assignment of operating altitudes or altitude limits during night and IFC flights to prevent mutual interference of friendly aircraft. Altitudes or altitude limits are assigned by the

corps flight operations center. Aircraft of units having primary interest in an area normally have priority on the lower altitudes; e.g., division aircraft normally have zone priority over corps aircraft. Aircraft operating on instrument flight conditions in this area require ground control by tracking type radar or other similar means.

b. Route Control. Route control is primarily utilized to the rear of division base airfields for Army air traffic operating under instrument flight conditions or at night without lights. Route control may also be used under daylight visual flight conditions during major air operations or when required for purposes of air defense. It may be utilized forward of division base airfields when required by major air operations.

- (1) *Army air routes.* Common Army air routes are established between airfields of major echelons to facilitate the flow of air traffic between these echelons, and between major airfields including division base airfields (but not forward of these). Primary routes are established by the army commander; supplemental routes by corps commanders, as required. Air routes are based on bearings from LF/MF (low frequency/medium frequency) beacons, normally with no more than 50 miles between beacons. Routes are established so as to avoid hazardous terrain obstacles and critical air defense areas.
 - (a) Air routes 25 miles or less between beacons are 5 miles in width ($2\frac{1}{2}$ miles each side of the centerline).
 - (b) Routes from 25 to 50 miles between beacons are 10 miles in width (5 miles each side of the centerline).
 - (c) Route radio beacons constitute compulsory traffic control reporting points for aircraft operating on instruments or at night without lights.
 - (d) Minimum route altitudes are established on each air route for the operation of fixed wing aircraft under unlighted night or IFC flights. This minimum altitude is normally established as 1,000 feet above the highest terrain obstacle on that air route.
 - (e) Traffic is separated on an air route by altitude and by time. Rotary wing aircraft normally have priority on the lower altitudes and may use altitude less than the route-minimum altitude if contact flight can be maintained. In fixed wing traffic, the shortest flights are usually assigned the lower altitudes.
- (2) *Special air routes.* Special air routes may be established for the specific operation of large numbers of aircraft, as when rotary wing aircraft units are employed. Control of

traffic on special air routes may be delegated to the commander of the aviation unit which utilizes the route, provided no conflict with other air traffic will result.

c. Point-to-Point Control. A point-to-point system controls IFC flights off air routes in the rear of division airfields. These flights may be conducted as straight-line flights between beacons or may be flown on an outbound track to intercept an inbound bearing of a different beacon. Air route control procedures, such as flight plan and position reports, are required when utilizing the point-to-point flight system.

d. Airfield Control. A traffic control zone is established at each major Army airfield in the combat zone: the field army base airfield, corps base airfields, corps artillery base airfields, division base airfields, and such other airfields as may be designated. A traffic control zone normally consists of a designated area surrounding both the airfield and the LF/MF beacon extending from the surface upward to a designated altitude, within which the airfield is responsible for the control of air traffic. Corps and army base airfields personnel maintain radio control of air traffic within their control zones at all times. Division and corps artillery base airfields personnel normally effect radio control of air traffic within their control zones only at night and under IFC. Airfield traffic patterns, instrument holding patterns, instrument letdown procedures, and IFC weather minimums will be established and reported to higher headquarters (for promulgation) by the aviation officer responsible for each airfield.

288. Identification Measures

Measures for the identification of Army aircraft in the combat zone are prescribed by the theatre commander. These identification measures are based on published allied and joint communications procedures, current identification procedures and criteria pertinent to Army aircraft as may be published, and the requirements of the air defense situation within the theatre. These measures are implemented by integration into the established air traffic control and communication system in the combat zone.

289. Terminal Control Operation

a. Traffic Patterns. The aviation officer at each echelon is responsible for establishing and promulgating traffic patterns for unit airfields within the command. When establishing traffic patterns, he considers existing regulations, the tactical situation, terrain, obstructions, and type and density of air traffic expected.

b. Control Facility. Airfield control facility personnel issue clearances to aircraft for the purpose of preventing air collisions and,

on the ground, aircraft and vehicle collisions. This facility also prevents unnecessary delays and permits proper use of the landing area by issuing and relaying information and clearances.

c. Radio. Radio is the normal means of controlling traffic within the control zone. Radiofrequencies and procedures are established by the aviation officer in accordance with existing regulations, directives, and communications restrictions.

d. Procedures. Terminal control procedures are established by the aviation officer or higher headquarters.

CHAPTER 15

ARMY AIRFIELDS AND LANDING AREAS

Section I. GENERAL

290. General

a. Army Aviation landing areas range from completely organized airfields to strips of terrain or roadway only large enough for safe landing and takeoff. The type of landing area to be used will depend on the tactical situation, the terrain, local civilian attitude, and the time available for preparing ground installations. For detailed discussion on Army airfields and landing areas, see TM 5-251.

b. Selection and development of the airfield is the responsibility of the aviation unit commander, who will coordinate with the supported unit commander and his staff to take maximum advantage of area security and available routes of communication. Required engineer support should begin as early as practicable.

c. Although each aviation unit will normally select and develop its own airfields, economy of effort and personnel, measures for local security, plans for aircraft employment, or a lack of suitable airfield sites may justify the use of a common airfield by two or more units. This decision will be made by higher headquarters, or by mutual agreement of the unit commanders concerned.

291. Types of Airfields and Landing Sites

a. Base Airfield. A base airfield is occupied and used as the primary base of operations by the major aviation unit organic to a command.

b. Flight Airfield. A flight airfield is occupied and used by direct support elements of the major aviation unit (examples: combat support flights, artillery flights).

c. Satellite Airstrip. A satellite airstrip, auxiliary to the regular airfield system, is an established but unoccupied airfield for fixed wing operations. Operations from such airstrips are normally of short duration.

d. Rotary Wing Landing Area (Site). A rotary wing landing area or site, auxiliary to the regular airfield system, is an established

but unoccupied area for rotary wing operations. Operations from such areas are normally of short duration.

292. Classes of Airfields

Army airfields are divided into three general classes based on standards of construction.

a. Pioneer. A pioneer Army airfield represents the lowest standard of construction which can be utilized under favorable operating conditions. Safety factors are at or close to the minimum required. The runway is limited to a sod or soil surface or, where suitable, to an existing road. Operations are frequently restricted almost entirely to favorable weather.

b. Hasty. A hasty Army airfield is built to provide an operable margin of safety. This type of field allows reasonably safe and efficient operations, except in prolonged adverse weather. The choice of finished runway will depend upon soil conditions, weather, time of year, availability of a particular kind of surfacing material, and anticipated length of time field is to be used. Portable surfacing is normally used.

c. Deliberate. A deliberate Army airfield is constructed according to established standards of safety and efficiency. The runway must have a well-graded, thoroughly compacted base with a flexible or rigid surface to be operable under all weather conditions.

Section II. RECONNAISSANCE

293. General

A pioneer airfield or heliport site may be selected after brief reconnaissance, keeping in mind the factors of minimum aircraft operating requirements, accessibility, camouflage, and concealment. On the other hand, the site for a fully developed, deliberate airfield will require detailed reconnaissance, since clever design cannot overcome basic faults of a poorly selected site.

294. Reconnaissance for Locations

Reconnaissance for airfield locations is best accomplished with combined map, air, and ground survey. Each aviator should know the characteristics of a good airfield since he may have to make the reconnaissance and site selection. The types of reconnaissance are described below:

a. Map Reconnaissance. A study of appropriate maps is first made to determine the location of favorable areas, proximity to the supported unit, type of terrain, and availability of access routes. Map reconnaissance alone is used only when additional methods are not practical. It may be the only possible method when displacing over

long distance or into areas previously denied (for example, amphibious operations and some river crossings).

b. Air Reconnaissance. Air reconnaissance usually follows map reconnaissance. Air reconnaissance alone is generally hazardous without followup by ground reconnaissance. It may be used in fast-moving situations when time will not permit ground reconnaissance, or when condition of the ground surface is readily apparent from the air. Availability and condition of access routes are determined during the air reconnaissance.

c. Ground Reconnaissance. A ground reconnaissance is made to determine the nature and condition of the surface area and to select exact locations for required airfield installations (bivouac, operations, maintenance, etc.). Ground reconnaissance alone is not wholly adequate, but aerial reconnaissance may occasionally be impractical. The ground reconnaissance party should have sufficient equipment and personnel to accomplish minor improvements of the field and receive aircraft and other elements of the aviation unit when it arrives.

d. Combined Map, Air, and Ground Reconnaissance. Combined map, air, and ground reconnaissance will be used whenever possible, particularly for deliberate Army airfields and heliports. This type of reconnaissance is most effective when—

- (1) Sufficient time is available, and weather and situation permit.
- (2) A partial estimate of conditions on the ground can be made during the air reconnaissance.
- (3) The best ground route to the new field can be determined.
- (4) The ground reconnaissance follows, or is made in conjunction with, air reconnaissance.
- (5) The appraisal of the area and field made during the air reconnaissance can be confirmed and advanced by the ground party.

Section III. SITE SELECTION

295. General

Criteria for selection of base and flight airfields are generally the same, except that space required for unit installations at the base airfield is normally of negligible concern for the flight airfield. Selection of satellite airstrips and rotary wing landing areas (sites) depends largely on the type of operations to be conducted, and anticipated length of occupancy. Instrument approach factors in site selection are given in paragraphs 308 and 309.

296. Area

An Army airfield must be large enough to accommodate every type of aircraft expected to use the field. Its design criteria are estab-

lished by the operational characteristics of the most critical model of the type aircraft using the field.

a. Design of the field depends upon the time and engineer effort available, the operational mission of the aviation unit which will use the field, the number of aircraft expected, the anticipated frequency of takeoffs and landings, the personnel and cargo to be accommodated, and the anticipated length of occupancy.

b. The area required for an Army airfield or heliport is affected by the mean temperature and altitude of the site, since these factors have a direct effect upon the length of required ground takeoff run. In general, a site should be selected at the lowest altitude consistent with other requirements.

297. Defensive Aspects

a. The site must be chosen so that the approach of the aircraft, as well as the site itself, will be hidden from enemy surveillance as much as possible, and located so that it can be easily protected from encirclement or from infiltration by the enemy. Dusty sites should be avoided because dust will reveal the operation of the aircraft and create a hazard to safe operations.

b. Camouflage considerations as discussed in *e*, below, are all-important.

c. A site with natural cover for the concealment of dispersed parking areas, maintenance areas, etc., is desirable.

d. The airfield should be located in an area which is defiladed from enemy fire and ground observation.

e. To maintain a tenable position for air operations from the site, the practicability of ground defense against both ground and air attack must be considered. Terrain favorable for defense provides observation, fields of fire, concealment, obstacles, and routes of communication. Natural obstructions in possible landing areas adjacent to the site assist defense, but clear areas adjacent to the site may have to be protected against airborne landings.

298. Routes of Communication

The adequacy of existing vehicle routes connecting the proposed airfield or heliport with unit command posts and supply points should be considered. Construction of new roads in the combat zone can be justified only under exceptional circumstances.

299. Proximity to the Unit Command Post

The airfield should be located close to the supported unit command post for maximum utilization and control of unit air operations. Generally, under combat conditions, an attempt is made to locate the air installation within the supported unit defensive area. For

many units it is advantageous to consider the selection of airfield and command post sites as a joint task and, if possible, to select an area that is satisfactory for both installations. This procedure is particularly feasible for units such as engineer battalions and groups, and higher echelons that normally can select their command post locations from a relatively large area. In such units, consideration is given to locating the command post in an area where an airfield or heliport can be developed without great engineer effort. When it is not practicable to locate the entire unit air installation near the supported unit command post, it may be possible to establish a suitable satellite strip nearby for daytime use and to base the aircraft at a more suitable airfield in the rear. Particularly in rugged, mountainous terrain it is often necessary to develop one central airfield from which the aircraft of several units can operate, and to use small satellite strips or roads near the command posts for daylight unit operations. Generally, the closer the unit air installation is to its command post, the more efficiently the unit commander can use his aviation unit.

300. Camouflage

Camouflage requirements must be considered in selecting the site for an Army airfield or heliport. A site that readily lends itself to concealment and one where the enemy would not expect to find an airfield is of major importance.

301. Meteorological Factors

Depending upon the type of aircraft to use the field, the amount of traffic expected, and the degree of permanency of the field, factors such as prevailing winds, smoke, fog, snow, haze, precipitation, and other meteorological conditions should be considered because of the adverse effect they may have on the operational use of the field. Climatological records on the exact site may not be available. Conditions noted in the general area of a site may vary from those which prevail at the site itself because of differences in altitude and topography. This is particularly true of downdrafts, cross-currents, haze, fog, and precipitation. Conditions may also vary at different times during the year. Ground haze is less likely to occur at high elevations, but many elevated areas are frequently covered with low-lying clouds. Sites near swamps, large bodies of water, or in narrow valleys are often subject to fogs. Industrial areas are frequently surrounded by industrial haze.

302. Hydrological Factors

Hydrological conditions (the height of the ground water table and its seasonal variations, the flood characteristics of streams bor-

dering the site, and tidal variations at coastal locations) are important, particularly for deliberate construction. Reconnaissance during the dry season may be misleading. Vegetation sometimes discloses evidence of seasonal seepage or rise in the ground water table. For example, reeds, sedges, cottonwoods, and willows thrive where seepage occurs, even though the seepage is seasonal. Tree trunks along streambanks scarred by the abrasive action of ice floes during the breakup indicate the elevation of extremely high water.

303. Obstructions (Glide Angles)

a. An airfield site free from all obstructions is preferable, but an approach zone free of obstructions at each end of the flightway meets minimum requirements. Manmade obstructions such as towers, stacks, spires, and pole lines can often be removed. Trees obstructing approach zones and safety clearance zones will be removed.

b. Consideration should be given to the profile of surrounding terrain, which may in itself be an obstacle. For example, in mountainous terrain, approaches to a field located in a steep or narrow valley may be limited by the surrounding terrain.

c. Besides physical obstructions, close attention should be given to aviator reactions since there is a strong, natural objection to landing over obstacles even though they are well marked and below the glide angle. An airfield on a plateau with steep sides falling away immediately beyond the overruns may have perfect approaches, but aviators will generally land well down the runway. A canal, ditch, bank, or pole line at the end of a runway has the same effect. The result of these reactions is equivalent to a shortened runway.

304. Maintenance and Operational Areas

Dispersal of aircraft and equipment is essential at Army airfields and heliports. When a site is being considered, sufficient space must be available for the suitable location and development of adjacent parking and storage areas, maintenance and refueling areas, and billeting areas.

305. Use of Existing Facilities

All existing facilities within the allowable area (such as roads, abandoned airfields, parking areas, etc.) should be investigated for possible utilization. The use of long, straight stretches of existing roads as a center "core" for an airstrip should be considered, especially where construction time is limited or where these roads occupy the only favorable site within an area. Utilization of a road for the runway is illustrated in figure 15.

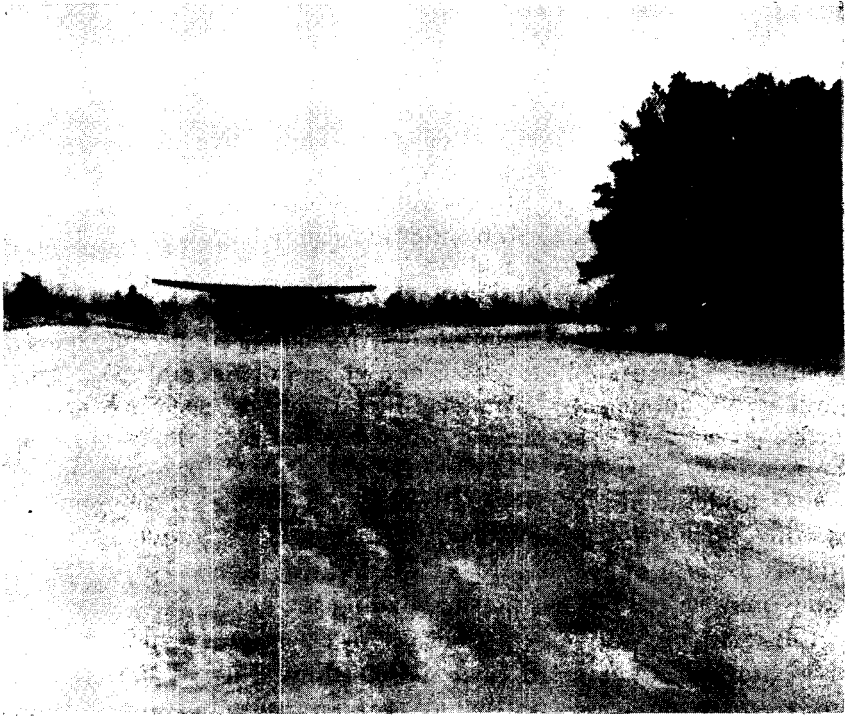


Figure 15. Utilizing roadway for landing area.

306. Consideration of Natural Conditions

a. Topography. The most desirable airfield site is one located on high ground, with sufficient slope for natural cross drainage as well as longitudinal drainage, and with a reasonably smooth surface which requires little earth-moving. Runway surfaces must be smooth enough to permit takeoffs and landings without damage to aircraft, even on pioneer fields. A rough runway surface may weaken structural parts of a fixed wing or rotary wing aircraft as the result of vibration during the ground run. Uphill takeoffs and downhill landings require longer runways. Low, flat, poorly drained ground should not be selected merely because it provides good approaches and can be easily graded and used during dry weather, except for certain pioneer fields. Where a choice must be made between a rough, well-drained site and one which is level but wet, it is necessary to compare the estimated time and effort required to grade the rough site with that required to drain and strengthen the wet one. The deciding factor may be the availability of engineer troops and equipment. Lower echelon units without direct engineer support are greatly restricted in site selection by topography.

b. Soils. Soil conditions in valleys generally lead to ease of grading but are such that rains cause rapid soil failure, and drainage is difficult. Soils on rising ground frequently contain more rock or are shallow so that a natural base which will sustain heavy loads can be found.

c. Drainage. Good drainage is vital to the proper functioning of an Army airfield or heliport. The basic requirement for deliberate fields is serviceability, regardless of weather conditions. Operations cannot wait for surface water to drain from an airfield or for subgrades to become dry and stable. Drainage facilities for hasty and deliberate airfields should be adequate to carry away water without overflowing ditches along runways or taxiways. The type of aircraft to use the field, soil conditions, and expected traffic will affect the effort to be expended in improving the drainage for any field. A sod strip on porous sandy soil may be satisfactory for a pioneer field, even during wet weather. The greater the traffic, however, the more important an adequate drainage system becomes. Airfields in rear areas or the zone of interior, where extensive engineer effort can be expended, should have a complete drainage system such as that provided for airfields for high performance aircraft.

d. Vegetation. In rear areas or the zone of interior, where concealment is not a required factor, vegetation is considered primarily from the amount of clearing and grubbing involved. In the combat area, available natural concealment in the vicinity of the proposed site should be considered. Vegetation adjacent to the strip can afford natural concealment for parked aircraft and installations. The ideal situation is a large open area surrounded by sufficiently large areas of vegetation to provide proper concealment.

e. Special Physical Phenomena. Any special physical phenomena peculiar to the area such as permafrost or volcanic activity should be thoroughly investigated for possible effects on construction or operations at the proposed site.

307. Availability of Local Materials and Labor

Where a base course is required for runways, taxiways, hardstands, and roads, the quantity of natural material necessary is a major item. Reconnaissance must include exploration for sources near the site that will yield adequate material in quality and quantity and sources of civilian labor if required.

Section IV. INSTRUMENT APPROACH FACTORS

308. Factors in Site Selection

Specified aviation units are equipped with the navigational equipment for establishing an instrument approach system at a base air-

field. Addition of an instrument approach system increases the factors which must be considered in selecting and occupying an airfield, as follows:

a. Topographical obstructions near the proposed location of the airfield.

b. Relative position of the airfield within the division, corps, or army sector.

c. Accessible location for an instrument approach facility.

d. Distance between the proposed airfield location and the forward edge of the battle area (FEBA).

309. Procedures for Installation and Implementation

Step-by-step procedures to be followed in the installation and implementation of an instrument approach system are as follows:

a. Topographical obstructions near the proposed location of the airfield.

b. Relative position of the airfield within the division, corps, or army sector.

c. Accessible location for an instrument approach facility.

d. Distance between the proposed airfield location and the forward edge of the battle area (FEBA).

Section V. OCCUPATION AND ORGANIZATION

310. General

The time and method of occupying a new airfield will depend upon the tactical situation, communications with the supported unit, and ground conditions at the new area. When extensive preparation of the new site is required, the aviation unit commander may have to augment the ground reconnaissance party or obtain engineer support.

311. Types of Occupation

a. Daylight Occupation. In the interest of security, occupation of an airfield should be conducted when practicable at dawn during advance movements and at dusk during retrograde movements. Movement should be by echelon, with communications maintained and operations continued from the old airfield until the new airfield has been established.

b. Night Occupation. Night occupation of a new airfield should be conducted only when daylight occupation is extremely impracticable. When night occupation is imperative, the ground party must enter the area during daylight hours and prepare the field for night occupation by the unit.

312. Organization

Organization of the airfield should begin promptly after selection. When selection includes combined air and ground reconnaissance, organization is begun by the ground reconnaissance party. The advance aviation echelon accomplishes as much of the organization as possible before arrival of the remainder of the unit. See figure 16 for a sample layout of an Army airfield.

a. Aircraft Parking Area. Dispersed and concealed parking areas must be located to permit minimum ground handling of aircraft but maximum concealment of ground tracks. A parking area for visiting aircraft should be selected near the operations center.

b. Refueling Facilities. The method of refueling aircraft will be determined by the type of refueling facilities available to the unit. It is generally preferable to carry fuel to the aircraft than to taxi the aircraft to the fuel source. POL supplies should be dispersed, sheltered, and concealed.

c. Operations Center. The operations center should be readily accessible to individuals arriving at the field by aircraft or vehicle. It should be located so that wire communications lines will not cross the field. The operations center includes facilities necessary for proper control of all unit aviation operations: files, records, publications, maps, situation maps, telephone and radio communications with the supported unit command post, and radio facilities for communication with aircraft in flight.

d. Motor Park. The motor park should be located in an area permitting dispersal and concealment of vehicles, and easy access to other aviation installations.

e. Bivouac Area. The bivouac area should be located in close proximity to the airfield. It should be large enough to accommodate all administrative installations and afford an adequate dispersion and concealment area.

f. Maintenance Area. The aircraft maintenance area should be accessible to aircraft and vehicles and afford adequate space and concealment. Except for minor maintenance performed in the parking area, aircraft are moved into the maintenance area for normal organizational maintenance.

g. Panel Markings. Until aviators become familiar with the new airfield, panels should indicate landing direction and usable limits of the airfield. A T-panel is placed at the downwind end of the field to indicate the direction of landing, wind direction, and near limit of the runway (app. XI). A single panel is placed at the upwind end of the airfield to mark the limit for landing roll. Panels are easily seen by the enemy and should be removed as soon as practicable. If panels are not available, personnel of the aviation

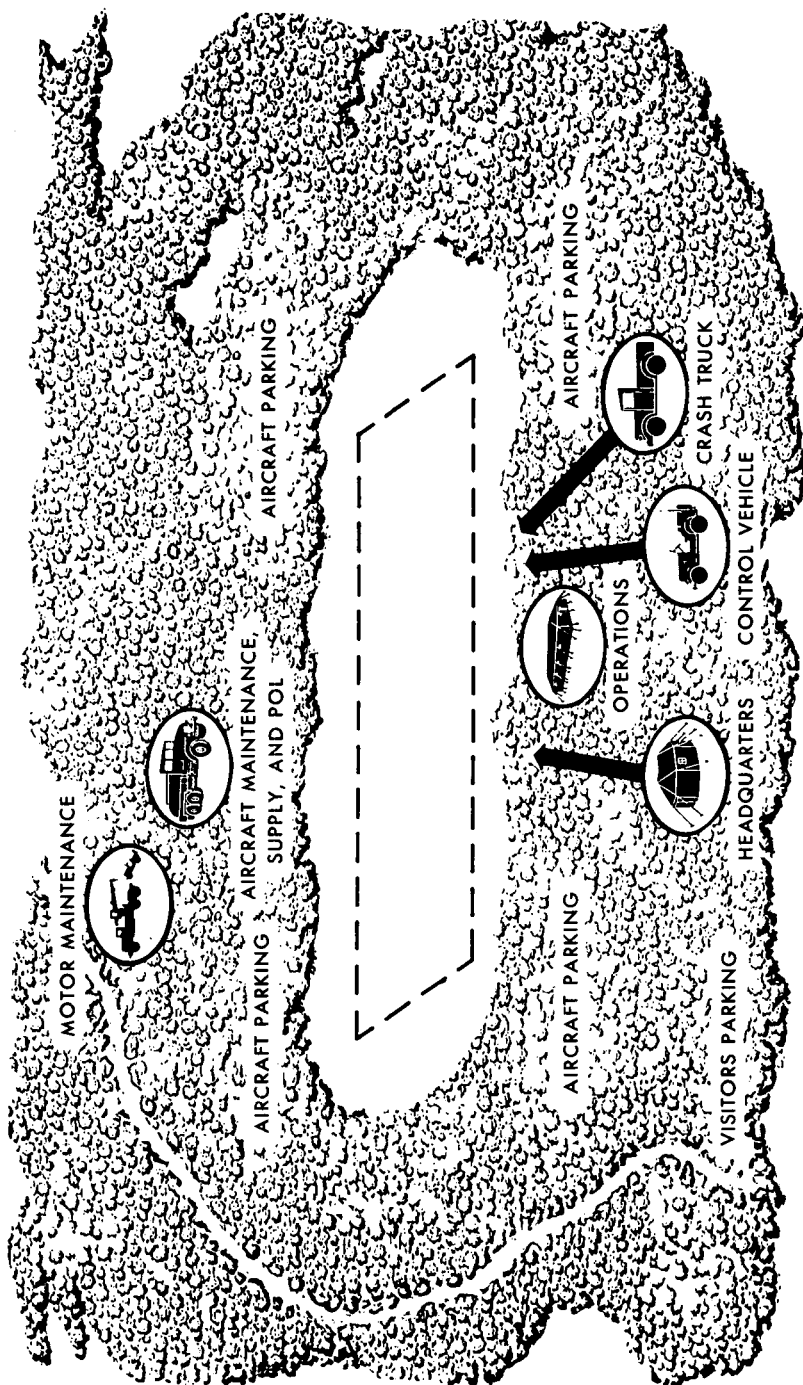


Figure 16. Sample layout of an Army airfield.

unit should mark usable limits with flags, flares, smoke pots, or other appropriate markings. Panel markings may be required for transient aircraft.

313. Sequence of Organization

Rigid rules governing the complete sequence of organization of airfields cannot be prescribed. The first three steps in the following list should be given priority in unit standing operating procedures:

- a. Establishment of radio communication with the supported unit.
- b. Organization of airfield security and contact with any friendly troops in the area.
- c. Selection of exact locations for installations of the aviation unit.
- d. Marking of ground routes leading into the area (if necessary).
- e. Planning and marking of supply and circulation routes to avoid disclosure of airfield location.
- f. Concealment and camouflage of elements of the aviation unit as they arrive and are installed.
- g. Organization of necessary internal wire communications.

Section VI. SEAPLANE FACILITIES

314. General

a. Army fixed and rotary wing aircraft may be equipped with either floats or amphibious gear for water operation.

b. Use of water areas for Army Aviation operations is advantageous in that there is a minimum expenditure of construction time and effort in preparation of the landing surface, and less likelihood that the landing and takeoff area will be damaged or destroyed by enemy action. An obvious limitation is that a suitable water area may not be available in the location desired; however, in most areas of the world, water areas such as rivers, lakes, seas, oceans, reservoirs, and canals are available within a reasonable distance of almost any ground location.

315. Site Selection

a. Water Area.

- (1) *Size.* An Army seaplane facility must be large enough to accommodate every type of aircraft which is expected to use it. Recommended minimum dimensions of the water area are a length of 2,500 feet and a width of 200 feet; the minimum depth of the water should be 3 feet.

Note. The length of 2,500 feet is based upon glassy water, no wind, sea level, and temperature of 59° F. Length should be increased at the rate of 7 percent for each 1,000 feet of elevation above sea level.

(2) *Current and water level variations.*

- (a) Currents affect size requirements of the water landing area only under extraordinary conditions. Landing and takeoff operations can be conducted in water currents in excess of 6 knots (7 mph), but any taxiing operation under the above conditions (between water lanes and shore facilities) will require the assistance of a surface craft.
 - (b) As a general rule, where the change in water level exceeds 18 inches, it will be necessary to utilize floating structures or moderately inclined beaching accommodations to facilitate handling of aircraft at a shoreline or waterfront. Where water level variations exceed 6 feet, special construction will be required to facilitate aircraft accommodations.
- (3) *Water surface conditions.* Open or unprotected water may become too rough under certain conditions to continue operations. Although an average Army aircraft equipped with floats can be safely operated in rough water which measures about 15 to 18 inches from crest to trough, crests of 18 inches or more will restrict normal safe operation.
- (4) *Sheltered anchorage areas.* Sheltered anchorage areas will be required where sudden or unexpected storms or squalls are likely. The anchorage area must be easily accessible from the onshore area, and located to permit unrestricted maneuvering of the aircraft when approaching the buoys.
- (5) *Bottom conditions.* Reservoirs and other artificial bodies of water are often located in natural land areas where stumps and logs were not removed before flooding. In such areas, the anchors and anchor lines will foul and, over a period of time, may create a hazard if the submerged objects rise to the surface or remain partially submerged.

b. Tactical Aspects of Site Selection. General principles discussed in paragraphs 295 through 299 are also applicable to seaplane facilities.

c. Operational Aspects of Site Selection. Applicable operational aspects of site selection as covered in paragraphs 300 through 305 are also applicable to seaplane facilities.

316. Design and Layout: Water Operating Area

Many natural areas will provide the required dimensions for seaplane operations without modification. Where the available water area is limited, the minimum water operating area must consist of one water lane for landings and takeoffs, and a taxi channel. A turning basin will be necessary in cases where turning must be

confined to a restricted area because of water depth requirements or other considerations. In some cases, anchorage areas will be necessary.

a. Water Lanes. Approach zones, currents, and direction of the prevailing wind must be taken into consideration when determining the direction of the water lane. When the water landing area consists of a single lane (covering the wind direction), the highest possible percentage of aerial coverage should be obtained. When single-lane operating areas cannot be oriented to take maximum advantage of the prevailing winds, the water lane may be shifted to utilize the greatest possible wind coverage in conjunction with water currents and approach zone requirements. A typical layout for a single water lane operating area is shown in figure 17.

b. Taxi Channel. Minimum width of the taxi channel should be 125 feet, although a width of 150 feet, or more, is preferred. These channels should provide direct access to the onshore facilities and, when possible, should be oriented so that approach to the ramp or float will be into the prevailing wind.

c. Turning Basins. Turning basins will be required where the use of the water area is restricted. A minimum radius of 125 feet should be available for surface turns.

d. Anchorage Areas. Where anchorage areas are provided, they should be furnished with maximum protection from high winds and rough water and positioned so that each aircraft will swing around its mooring while anchored. The space needed is determined by wingspan and length of aircraft, length of line and bridle, and lowest water level.

317. Design and Layout: Shoreline Area

Shoreline installations are partly on land and partly in the water. They perform two general functions: servicing, loading and unloading, handling, and tieup facilities for seaplanes in the water; and haul-out facilities for removing seaplanes from the water.

a. Ramps. Slope for ramps should not be steeper than 7 to 1. For most Army aircraft equipped as seaplanes, a ramp with a depth of 18 inches is adequate, and a depth of 3 feet should be adequate in all cases. The recommended ramp width is 20 feet, 15 feet being the minimum. All spikes, nails, and bolts used in the construction of the ramp should be countersunk to avoid damage to floats or tires.

b. Piers. Piers or fixed overwater structures can be utilized where the variation in water level is 18 inches or less. The pier should extend into the water to a point where the water depth is adequate for types of aircraft to be handled.

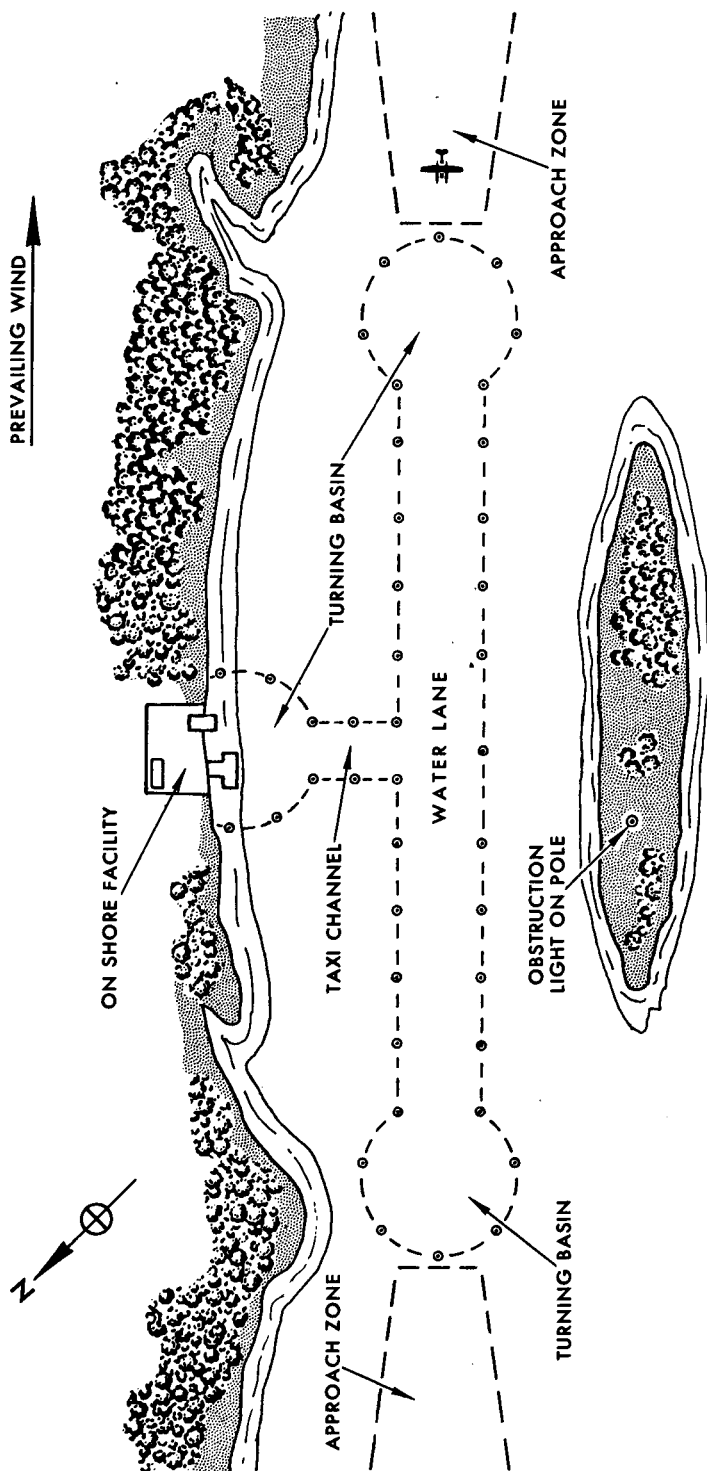


Figure 17. Single water lane operating area.

c. Slipways. In deliberate construction, slipways (fig. 18) can be provided for the anchoring and protection of individual aircraft. The principal requirement for this type of installation is that it be located where the change in water level is not more than 2 feet and the minimum depth of water is 2 feet. A gate should be provided to reduce wave action, and some form of bumper protection, such as old vehicle tires, should be attached to the inside of the rear wall, sides, and gate to prevent damage to aircraft floats.

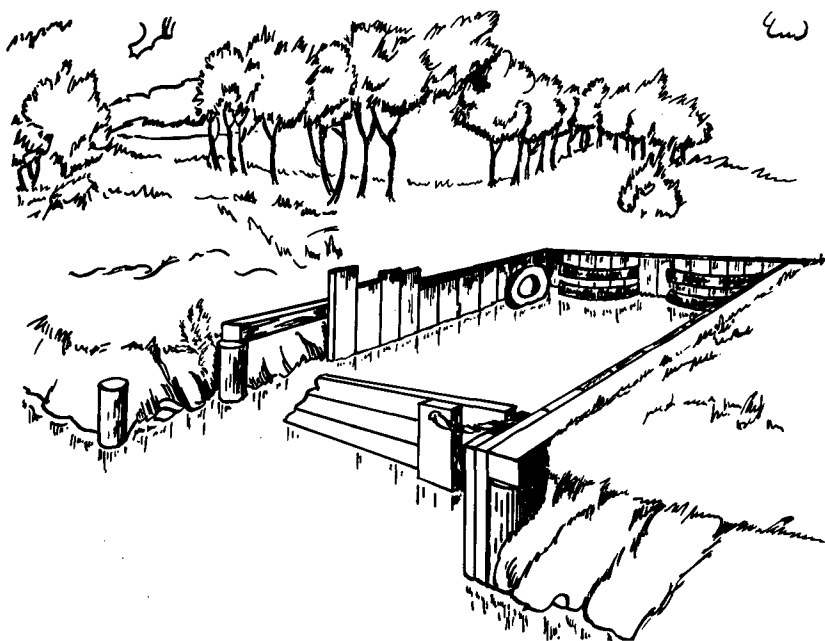


Figure 18. Slipway.

d. Floats. Floats offer the greatest flexibility in providing docking facilities, since they ride with wave actions and are satisfactory in areas of great or negligible water level variations.

318. Visual Air Marking

In the zone of interior or other approved locations, the standard seaplane visual air marker (fig. 19) is painted on a flat, paved surface in a conspicuous location with contrasting paint. In the combat zone, panels can be used to form a symbol as near standard as possible.

319. Lighting

a. Lighting for night operations must be similar to the lighting of Army airfields and heliports. Such lighting installations are

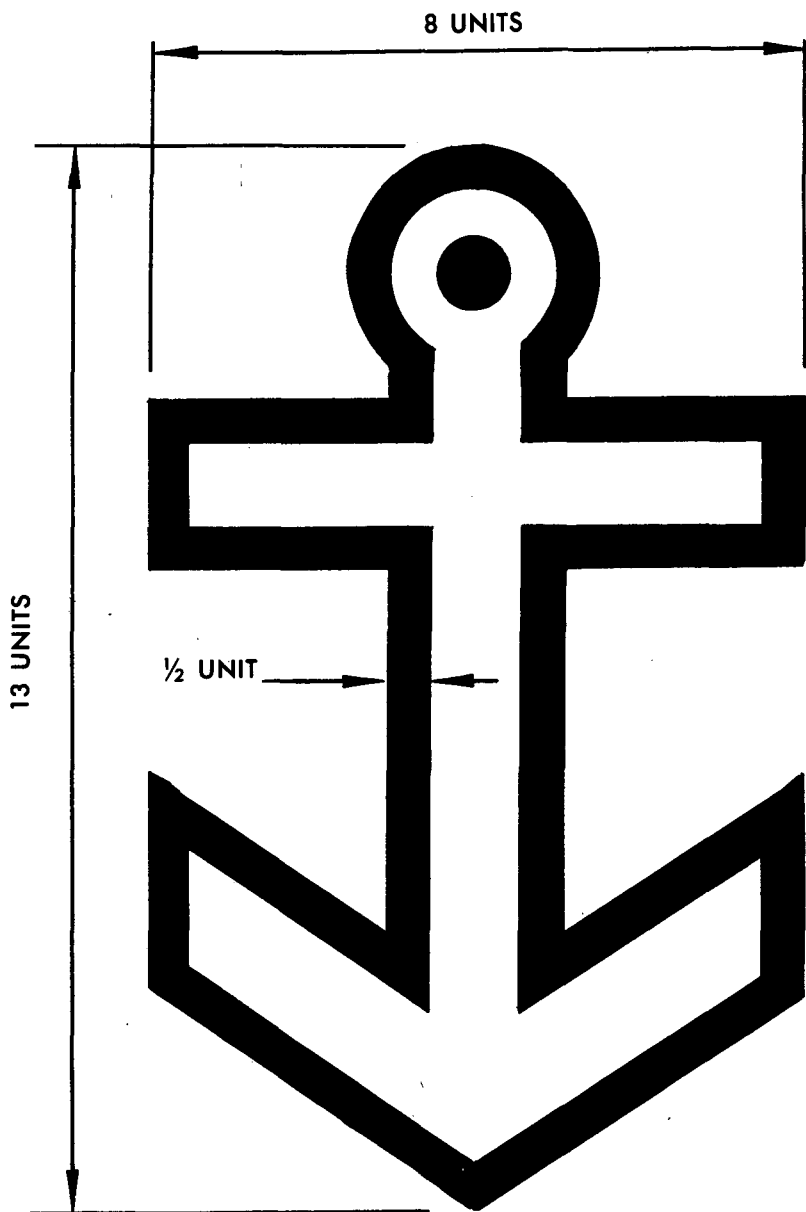


Figure 19. Seaplane visual air marker.

most frequently associated with semipermanent and permanent facilities. One of the simplest methods of lighting is to install portable, locally operated lights on suitable buoys or floatation gear anchored in position.

b. Seaplane facilities intended for use during the hours of darkness will be provided with one or more of the three types of lighting defined below:

- (1) Double-row lighting which consists of two lines of channel lights and associated threshold lights for defining the area intended for the landing and takeoff run of the aircraft.
- (2) Single-row lighting which consists of a single line of lights and associated threshold lights for indicating the preferred location and direction for the landing and takeoff run of aircraft.
- (3) Boundary lighting which consists of boundary lights and range lights which define the limits of the safe landing and takeoff area.

Section VII. LIGHTING

320. General

a. Army aircraft will seldom operate at night from fields in immediate forward areas, since lighting facilities necessary for safe takeoff and landing may reveal the position of the airfield to the enemy. This is, however, less true of rotary wing than of fixed wing aircraft; a single shielded light, or a landing light device to project a beam at a preset angle, is adequate.

b. Airfields located in other than immediate forward areas, as discussed above, may utilize lighting systems that range from permanent lighting to nothing more than vehicular head lamps.

321. Methods of Lighting

a. *Permanent Lighting Systems.* Permanent lighting systems utilized at permanent installations include landing lights, runway lights, lights for taxiways, obstruction lights and, usually, some type of rotating beacon.

b. *Army Airfield Lighting System (Portable).* Two portable field lighting kits used are lighting set No. 6, and supplementary set No. 24. Airfield lighting set No. 6 is designed for use in the combat zone, while supplementary kit No. 24 contains items used to replace or augment airfield lighting set No. 6 in zone-of-the-interior installations.

- (1) *Airfield lighting set No. 6.* Airfield lighting set No. 6 contains a 3-kilowatt generator and sufficient lights, cables, and transformers to light a runway 200 feet wide and 2,000 feet long. Each light is equipped with a combat hood to control the direction of the light. Also included in the kit is a glide angle indicator which emits a beam of

light that will indicate to the aviator whether he is too low, correct, or too high on his final approach.

- (2) *Supplementary set No. 24.* Certain items of equipment are included in supplementary set No. 24 to provide additional lighting in a noncombat area. The combat hoods included with airfield lighting set No. 6 can be removed and replaced with clear glass lenses for conventional runway lighting. Additional green lights for use as threshold lights at the opposite end are included. The supplemental set also contains obstacle lights, masts, guy cables, extra lenses, lamps, and a traffic control lamp.

c. *Army Heliport Lighting System (Portable).* Lighting at Army heliports is provided by heliport lighting set No. 7, and supplementary set No. 25. Heliport lighting set No. 7 is designed for use in the combat zone, while supplementary set No. 25 contains items used to replace or augment the basic set in noncombat area installations.

- (1) *Heliport lighting set No. 7.* This set includes the same glide angle indicator as the airfield lighting set No. 6 (par. 321b(1)), a 1½-kilowatt generator, two small flood-

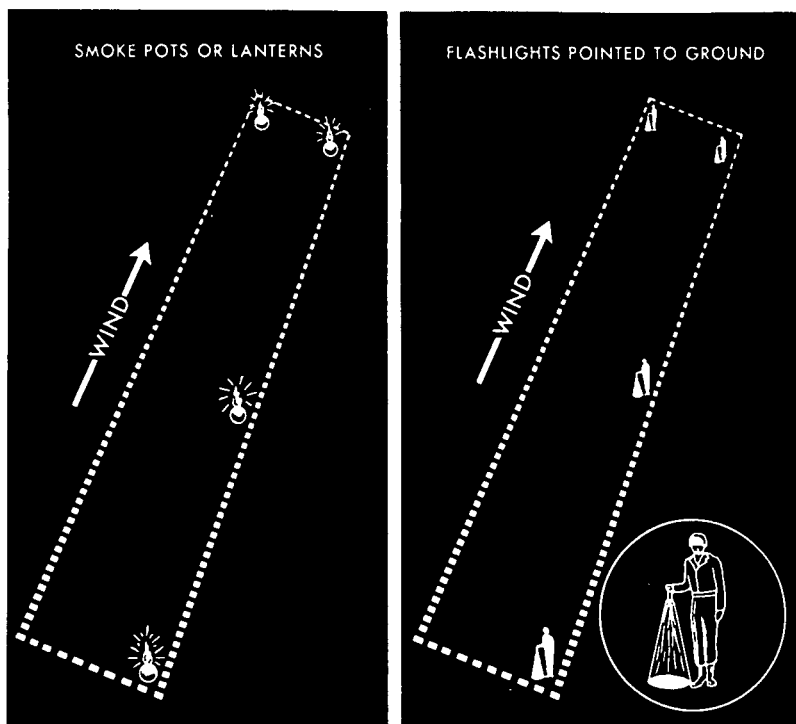


Figure 20. Minimum lighting expedients.

lights mounted approximately 12 inches above the ground facing each other at a distance of about 100 feet, and necessary accessory equipment. The light emitted from the floodlights is controlled so that the lights cannot be seen from above, and only the ground immediately in front of the lights is illuminated sufficiently to enable helicopters to land.

- (2) *Supplementary set No. 25.* This set contains additional items, including additional lights, which are set out in the form of a square approximately 200 feet on a side.

d. Expedients. Expedients may be used for lighting if issue equipment is not available. Lanterns, smudge pots, vehicle headlights, or reflectors may be used to delineate the runway edges. Figure 20 shows two suggested methods of employing minimum lighting expedients for night landings.

Section VIII. SECURITY

322. General

The local security of a base airfield is the responsibility of the aviation unit commander. If more than one unit utilizes the same field, the senior commander will be responsible. The aviation officer (division, corps, or army) is responsible for the formulation of an area defense plan in accordance with local security plans. Local security of forward airstrips is the responsibility of the aviation officer in charge. Area security will be provided by the supported unit. Limited organic firepower and personnel will require the extensive use of passive defense measures for airfield sites, including mobile evacuation of the unit.

323. Active Defense

- a. (1) Timely and accurate air warnings of hostile air activity is a primary means of aircraft defense. If the in-flight aviator receives air warnings in time, he can undertake appropriate defensive measures before attack. Air warning broadcasts are made by flight operations centers in each corps and army service area. All airfields are equipped to receive air warnings on established ADA intelligence net. An emergency radio channel is allotted to air warning reception by Army aircraft possessing required radio equipment; for aircraft not so equipped, with retransmittal of net warnings by flight operations on tactical channels.
- (2) Information on air alerts, CBR attack, fallout, atomic strikes, and similar information of an urgent operational

nature that would apply to all friendly units will be transmitted over a warning net (division, corps, or army).

b. Air defense artillery units or detachments will be utilized at or near airfields when available and when the tactical situation warrants.

c. Aviation unit enlisted personnel are trained as infantry and will be capable of establishing a perimeter defense for the unit. Suitable perimeter defense for smaller units usually requires augmentation of personnel.

324. Passive Defense

The aviation company commander or the unit aviation officer is responsible for passive defense measures, which includes training of aviation unit personnel in the interrelated importance of discipline, camouflage concealment, dispersion, and first aid. Passive defense is the primary method of protecting an airfield, and all available airfields will be used to assure adequacy of aircraft dispersal against atomic weapons fire. Aerial movements must be scheduled in a manner which will prevent aircraft concentrations at one site. Shelters will be dug or constructed for personnel, supplies, and aircraft. The guiding theme for successful passive defense should be dispersion in time and/or space of all equipment and personnel.

a. The airfield site should provide maximum cover and concealment, including defilade where practicable, and all aircraft should be camouflage painted (par. 194).

b. Details of carefully formulated and executed camouflage plans, with suggestions for continual inspection and improvement, can be found in FM 5-20E. Personnel maintain camouflage discipline at all times.

c. Extent of dispersal is influenced by the ability to perform assigned missions and provide cover, concealment, and local defense.

d. Deception techniques are used to the maximum degree practicable. Depending upon enemy aggressiveness and capabilities, construction of one or more dummy airfields may be necessary. A dummy airfield must be realistic enough to be recognized as an airfield, avoiding too obvious exposure; the purpose is to attract attention of enemy searching the area for a suspected airfield.

e. When inadequate defilade of the airfield exists, the *contour approach* technique should be employed by aviators. Contour approach technique is accomplished by descending to the lowest possible altitude at some distance from the actual field (possibly over a dummy airfield), and approaching the field by a low-level route,

taking advantage of all existing cover and concealment. A similar roundabout course is taken after takeoff and departure from the field.

f. Alternate airfields are established, improved, and developed as practicable for immediate occupancy in case the primary field becomes untenable.

g. The aviation commander is responsible for defensive training of his unit and an adequate SOP against CBR attack. See FM 21-40 for details.

CHAPTER 16

TRAINING

Section I. RESPONSIBILITY

325. General

The organizational structure and mission of Army Aviation units call for decentralized execution of missions; therefore, these units will seldom, if ever, operate in a tactical situation completely intact. This condition creates a training requirement made more complex by the number of specialized personnel in aviation units. Commanders of these units must prepare and implement a flexible training program which will not impair the operational support capability of the unit. This chapter will serve as a guide for the phase training of newly organized as well as operational aviation units and methods to accomplish the requirements of each training phase.

326. Command Responsibility

The unit commander is responsible for training his unit to perform the mission for which it is organized as well as other assigned missions. He plans, conducts, and supervises the training of his unit. Within the directives and policies of higher headquarters, he specifies training and assigns responsibility for its conduct, insures that performance and proficiency standards are consistent with those of Department of the Army, and procures and controls training facilities, aids, and equipment. Staff members assist in the planning and supervision of training pertaining to specialized functions. Commanders will use AR's 220-50, 220-60, and 220-70 as guides in the supervision, administration, and training of their units.

327. Aviation Officer Staff Responsibility

The aviation officer is responsible for assisting the staff in establishing master training schedules, technical training programs, and unit training schools. He supervises all aviation training of aviation units.

Section II. MANAGEMENT

328. Preparation

Thorough preparation by the instructor and effective presentation of instruction by coordinated explanation, demonstration, application, and examination are most important. Every effort must be made to insure that instruction, whether classroom, field, or on-the-job training, is carefully prepared and presented in an understandable, interesting, and dynamic way. Fundamental training doctrine and principles of training are outlined in FM 21-5. Detailed instructions for aviation training are found in FM's, TM's, and appropriate ATP's. Special training instructions are published in training circulars and periodic training directives. Department of the Army publications, training films, filmstrips, and visual training aids are listed in DA Pamphlets 108-1, 310-1, 310-2, 310-3, 310-4, and 310-5. To accomplish the training mission effectively, additional necessary training aids should be prepared. All instruction and training should follow these recognized steps:

- a.* Instructor preparation.
- b.* Instructor explanation.
- c.* Instructor demonstration.
- d.* Student application.
- e.* Student examination.
- f.* Instructor-controlled discussion.

329. Equipment

For effective training, an aviation unit needs to have available all organic equipment. If the equipment is not available or is inadequate, every effort to obtain it must be made through proper supply channels. Because of the inherent complexity of aircraft, particularly rotary wing aircraft, lack of critical parts and/or maintenance equipment necessitates grounding of the aircraft until established standards of operation and maintenance are met. This action virtually curtails any continuation of training. Field expedients cannot be substituted for critical parts and equipment peculiar only to aviation units. An effective training program is dependent upon proper utilization and economy of equipment.

330. Training Time

A general breakdown showing total time to be devoted to each subject, based on either a 40- or 48-hour week is given in the appropriate ATP's for active Army and Reserve component units. The hours of instruction prescribed in these ATP's are considered adequate to introduce subjects. Proficiency can be attained by application, through integrated and concurrent training. The train-

ing week as set forth in an ATP is a minimum training week; night operations and bivouacs require additional time. For an aviation unit of company size or larger, at least four (4) weeks of the unit training time will be spent in bivouac and as a minimum, one-third of all applicatory flying training and tactical training will be conducted at night. The specific number of weeks to be spent on the various phases of training is published periodically by the Department of the Army.

331. Training Areas

Every effort should be made by the unit commander to acquire as many and varied types of landing areas (road strips, strips containing barriers, contoured strips, etc.) as needed to insure aviator proficiency. Suitable training areas adaptable to training the unit in the selection and development of an airfield should be available. When possible, a different area should be used for each bivouac and field exercise to give the unit practical experience and to validate the application of training. For training purposes, the commander should also take advantage of training his unit in different seasonal and geographical environments, such as mountainous regions and deserts, which may be available within a reasonable range of his permanent location.

332. Supervision

Supervision is the best means by which the commander may influence the training and combat readiness of his unit. He may reserve for himself the function of supervision as a command prerogative, or he may designate members of his staff to assist him in supervising training. The purpose of supervision is to make certain that subordinates comply with the intent of directives, to help them execute specific requirements, and to know when instructions are proving inapplicable so they can be changed.

333. Inspections

a. Each command level is responsible for the training of subordinate units. Frequent training inspections, covering all phases of training, are made to check on the progress of training and to determine which phases must be stressed to reach required standards. Aviation personnel are first tested in their individual military and technical proficiency, and then on their abilities as members of an aviation unit. Actual successful performance by the man being trained is the only true test of training.

b. Inspecting officers must be just, impartial, and constructive in their criticism. They must help and teach, as well as uncover

faults and deficiencies. Inspections are timed to avoid interfering with the training program. In this respect, it is desirable for several inspectors to conduct their inspections simultaneously.

Section III. ESSENTIAL TRAINING PHASES

334. General

In this section emphasis will be placed on the advanced individual and unit phases of training. With the exception of newly organized units, most aviation units are comprised of personnel who have received their basic individual training and have already been awarded a specialist MOS (military occupational specialty) through completion of a course of instruction at a service school. In the event of mobilization, there is a possibility that aviation units would have to conduct basic individual training. This training would be conducted in accordance with ATP 21-114.

335. Advanced Individual Training

a. General.

- (1) Advanced individual training starts upon assignment of an individual to a TOE position and continues throughout the training cycle. Requirements exist for conducting training in certain phases of unit training during each training cycle or during preparation for mobilization. Consequently, individual training normally cannot be accomplished in the ideal sequence desired, but must be integrated into the training cycle at the point most suitable to local conditions and requirements. Although the advanced individual training is broken down into subphases as discussed in *b*(1) and *b*(2) below, the instruction will not be presented in separate blocks; it will be integrated, and the training will be conducted as a single training phase. Personnel who complete their training in advance of the majority of the unit will undergo practical training in operations. Individuals requiring a longer period of specialist training should complete their instruction during the basic unit phase.
- (2) During the advanced individual phase of training, aviators within the unit will be concerned with developing proficiency in basic as well as tactical flight maneuvers. Practice should not be limited only to missions anticipated to be requested by the supported units. Where possible, all transition training should be completed during the advanced individual phase.

b. Objective and Procedures.

- (1) The advanced individual phase of training may be broken down into two subphases: the general training phase and the specialist training phase. The purpose of the general phase is to provide individuals with advanced training in general military subjects, without regard to TOE assignment or specialty fields, prior to commencement of the unit training phase. All personnel within the unit receive the instruction set forth in the general training phase. Personnel performing required administrative, service, and maintenance functions in units attend the instruction in the general subphase to the maximum extent consistent with necessary operational requirements. Where appropriate, branch training and administrative services and functions will be integrated.
- (2) The purpose of the specialist subphase is to qualify the individual to perform the job required by his TOE assignment. ATP's give a detailed breakdown of the specialists to be trained. The training requirements for these specialists are further broken down into three categories: school trained, portion school trained, and unit trained.
 - (a) Dependent upon availability of school quotas, those specialists shown as "school trained" in the ATP should be trained at service schools. Those individuals unable to attend a service school due to limited allocation of quotas or for other reasons will be trained in the unit of allied specialties until such time as attendance at the appropriate service school is possible.
 - (b) Dependent upon availability of school quotas, a portion of those specialists shown as "portion school trained" in the ATP should be trained at service schools. Commanders will insure that personnel to attend service schools are phased from the unit in such a manner that, upon their return, they may be used to train other personnel of a like MOS within the unit. Guidance for the training of other individuals of this category will be contained in Army Subject Schedules for the MOS technical training of individuals.
 - (c) Specialists shown as "unit trained" in the ATP will be trained in the unit. Guidance for the training of these individuals will be contained in Army Subject Schedules for the MOS technical training of individuals. However, because of limitations of qualified instructors, equipment, and facilities, or in the case of a low-density MOS, it may be impracticable to conduct this training in the

unit. Plans should be made to procure qualified personnel through local transfer, to accomplish their training through attendance at troop schools, or to attach them for training to other units or installations having the required training capacity.

336. Replacement Training

All replacements received by the unit after it has completed the unit training phase must be qualified in general aviation subjects. If possible, these replacements should be given the full advanced individual training phase.

337. Unit Training

The unit training phase is broken down into two subphases: the basic unit phase, and the advanced unit phase. The unit training phase of an aviation unit consists of training in all phases of combat operations. During this phase the unit spends much time in the field operating under simulated combat conditions. Increased emphasis is placed on leadership, administrative efficiency, unit integrity, teamwork, morale, and supply economy. Competitive exercises between subordinate elements can be used to advantage to promote proficiency performance of tasks and pride of individuals in their unit.

338. Objectives

a. The objective of unit training is to produce a unit capable of functioning as a team and qualified to perform its operational mission as stated in section I of the unit's TOE.

b. The objective of the basic unit training phase is to develop effective and coordinated sections and teams from individuals who have learned particular skills and techniques during the advanced individual training phase. These skills and techniques will be progressively developed to meet subordinate element requirements, with the view of ultimately producing an efficiently functioning unit. The basic unit training subphase is further divided into a general training phase and a section training phase, which are integrated where appropriate. All enlisted personnel receive the general training; the various sections of the unit receive section training allied to their specialty.

c. Training during the advanced unit training phase is designed to implement training previously received and to mold the subordinate elements of the unit into a smoothly functioning unit. At least four weeks of the unit training time will be spent in bivouacs conducted under an assumed tactical situation. Particular attention will be given to—

- (1) Dispersion.
- (2) Concealment from enemy observation.
- (3) Local security (including means of combating guerillas and infiltrators).
- (4) CBR protective measures.
- (5) Individual and unit protective measures applicable to modern nuclear warfare.

d. Operations in bivouac during the unit training phase will afford the best opportunity for aviators to apply the individual proficiency developed in the advanced individual training phase to the actual performance of aviation support missions. Individual aviators and sections are combined to operate under simulated tactical conditions as a smoothly functioning unit. During this phase the capabilities and limitations of the unit are clearly determined. Any additional training necessary to ready the unit for field exercises and maneuvers is also determined. Every effort must be made to combine the training of the various support elements of the aviation unit with those of the supported unit. This combined training phase promotes maximum coordination and understanding between supporting and supported units during combat, and will necessarily have to be integrated throughout the unit training phase of both the aviation unit and the supported unit.

339. Field Exercises and Maneuvers

a. Field exercises and maneuvers are the media for the application of tactics and techniques to specific situations under simulated combat conditions. They are intended to integrate components into an effective and coordinated unit and to insure the successful performance of operational missions. Their success depends upon thoroughness of preparation, intelligence of direction, and the amount of realism afforded. The use of aggressor troops contributes to realism in training. The initiative of subordinates is tested by unexpected attacks, both air and ground, simulated or real, and by the assessment of casualties. Such exercises reflect all functions performed by the unit and require maximum teamwork. Exercises will include, but are not limited to, the following:

- (1) Performance of all normal mission capabilities.
- (2) Signal communications, including transmission security and alternate means of communications.
- (3) Liaison.
- (4) Intelligence, stressing the accurate, prompt, and complete reporting of information.
- (5) Evasion and escape, concealment and camouflage.
- (6) Individual and unit protective and defensive measures, both active and passive, applicable to nuclear warfare.

- (7) Use of demolitions; unit action against air, airborne, and ground attack; and means of combating guerillas and infiltrators.
- (8) Route reconnaissance and march control.
- (9) March discipline; convoy organization, control, and discipline.
- (10) Organizational maintenance in the field and on the march.
- (11) Bivouac procedures including field messing and sanitation.
- (12) First aid for casualties and mass evacuation.
- (13) Supply procedures, leadership, cadre, and key specialist training.

b. A critique will be held following each exercise, with emphasis on the purpose of the exercise. Good as well as bad points will be observed, and methods of correcting deficiencies discussed.

340. Concurrent Training

a. *General.* To increase the realistic effectiveness of training, arbitrary boundaries between training phases are to be avoided and efforts made to integrate and relate each subject to another subject and all subjects to the unit mission. This will entail to some degree the concurrent conduct of advanced individual and unit training. Judicious application of this principle, without violating that of logical progression, will result in maximum teamwork and military effectiveness for time expended. Review of basic military and technical subjects must be regularly incorporated into the progressive training phase. Tactical requirements are included in many technical exercises. Throughout all phases of training, and particularly during unit training and field exercises, initiative and a sense of responsibility must be developed in officers, noncommissioned officers, and other personnel with potential leadership ability. Each commander must integrate leadership exercises throughout all training phases, particularly during periods of tactical training. Command is decentralized and interference with subordinate commanders is kept to a minimum consistent with coordinated effort. All personnel must be instilled with the idea that they must decide and act quickly in a situation which requires immediate action and where specific orders are not available.

b. *Supply Economy.* Throughout all training phases, every opportunity must be used to stress supply economy. All aviation personnel must be thoroughly trained to understand that, particularly in theatres of operation, supply is a critical factor. Training and supervision of all personnel in the conservation, care, and maintenance of individual and organizational supplies and equipment must be continuous. Definite responsibility for each item of equipment and supply in storage or in use is placed upon a particular officer or enlisted man.

CHAPTER 17

INTELLIGENCE, EVASION, AND ESCAPE

341. General

By extending observation capabilities of the unit, Army Aviation provides the major portion of combat intelligence information obtained.

a. By means of aerial observation, reconnaissance, surveillance, and aerial photography, precise data can be secured on the strength, location, and disposition of enemy ground forces, defenses, weapons, population centers, industrial sites, civilian activities and movements, indications of enemy morale, discipline, transportation activities, and tactical capabilities. The aviator and observer do not evaluate or interpret the facts observed. Observations are recorded in flight and presented to the debriefing officer immediately following completion of the mission. Intelligence information may be reported in flight by radio if such action is justified.

b. In addition to collecting intelligence information, Army Aviation can expedite dissemination of air delivery of intelligence reports. In this role it functions as a courier agency (par. 24).

c. The G-2 (S-2) coordinates and supervises the employment of Army Aviation in its intelligence role, including employment of trained aerial observers.

342. Intelligence Officer

G2 will attach qualified intelligence representatives to the aviation unit operations section for briefing and debriefing of aerial observers and pilots. These representatives provide the latest intelligence data significant to the accomplishment of these missions for which the aviation unit is responsible. They brief and debrief aerial observers and aviators on specific information to be sought on the missions.

343. Intelligence Functions

The intelligence functions of Army Aviation units include:

a. *Knowledge of the Enemy Situation.* Maintenance of a situation map which shows—

- (1) Location, disposition, and strength of known enemy units.
- (2) Location, size, and number of known enemy weapons positions.
- (3) Location, range circles, and radar frequencies (if applicable) of enemy air defense artillery.
- (4) Location of enemy airfields (when appropriate).
- (5) Location of enemy barrage balloons (if applicable).
- (6) Zones covered by enemy radar-warning net.
- (7) Location of known launching sites, and range of ground-launched missiles.
- (8) Searchlight areas.

b. Briefing of Aerial Observers and Aviators. The G2 representative's briefing includes the preparation of intelligence briefing data (checklist) to include:

- (1) Mission.
 - (a) Purpose of mission.
 - (b) Target area(s).
 - (c) Weather situation (if staff weather officer is not available).
 - (d) Landmarks and other target identification.
 - (e) Specific information desired.
- (2) Enemy ground defenses at the target mission area and en route.
 - (a) Air defense artillery and ground fire location and capabilities.
 - (b) Searchlight and air defense missile areas.
- (3) Enemy air activity and capability.

c. Interrogation of Aircrews. Interrogation of the aviator-observer team on their return from missions is conducted to—

- (1) Determine results of mission and degree to which accomplished.
- (2) Obtain combat information relative to terrain, weather, and enemy, to include location of new units, weapons, vehicles, etc., and indications of enemy activity and movement.

d. Dissemination. The aviation unit will prepare, transmit, and disseminate (orally, graphically, or written) as directed:

- (1) Complete report of information obtained on aerial missions.
- (2) A preliminary summary of mission activities.
- (3) A first-phase interpretation of information obtained for the aviation unit commander, aviation crews, and tactical and technical personnel.
- (4) Information obtained in weather debriefings should be forwarded to the Air Weather Service Facility previously

selected by the Staff weather officer to receive weather information from that sector.

(5) Other special reports as may be required.

344. Counterintelligence Functions

Counterintelligence functions of Army Aviation units include:

- a.* Security intelligence and censorship.
- b.* Direction and supervision of camouflage and dispersion.
- c.* Maintenance of communication security.

345. Evasion and Escape

In modern warfare, aviation personnel may be isolated from their units or forced down in enemy territory where rescue (particularly at night) is impossible. Under such circumstances, aviation personnel will make every effort to evade capture and return to friendly forces, or, in the event of capture, to escape and return. Since it is the duty of each individual to evade capture or to escape if captured, he must understand and exploit evasion and escape techniques. Physical stamina is required and unit training for these operations will include a vigorous physical training program. The aviation officer at each level of command will coordinate and integrate evasion and escape plans with the G2 (S2) of that command. For full coverage of Evasion and Escape, see FM 21-77 and FM 21-77A.

CHAPTER 18

SEARCH AND RESCUE OPERATIONS

Section I. BASIC CONSIDERATIONS

346. General

a. Army Aviation search and rescue operations, particularly effective in rapidly moving combat situations, provide a rapid means of returning isolated individuals and/or small units to friendly lines. This directly influences combat effectiveness, improves morale, and denies the enemy a source of information.

b. Successful search and rescue operations are conducted with minimum loss of time and with maximum coordination.

c. Darkness or adverse weather may, in some cases, make such operations impossible.

347. Responsibility

a. The responsibility for search and rescue operations in the combat zone rests with the division aviation officer or with commanders of subordinate detached elements within their zones of action. Before initiating search and rescue operations, the commander concerned must be consulted for the general effect such a mission will have on the overall mission of the unit. The G2 (S2) must be queried for information concerning enemy air and air defense capabilities.

b. The aviation officer must establish and disseminate throughout the unit a standing operating procedure dealing with operational phases of search and rescue, apart from any information required by the operations officer (to organize personnel and procure necessary equipment). The standard operating procedure must include:

- (1) Designation of and coordination with other agencies for supporting fires and air cover.
- (2) Methods of reporting location of individuals to be rescued and the enemy situation in the immediate area of rescue.
- (3) Designation of equipment to be brought out with rescued personnel, if any.
- (4) Search and rescue communication procedures and channels.
- (5) Search patterns.

- (6) Other information appropriate to the successful completion of the operation.

Section II. SEARCH AND RESCUE OPERATIONS

348. Aircraft

To some extent, all Army aircraft possess the capability of performing search and rescue missions. Rotary wing aircraft are, however, best suited for rescue operations because they can operate from small unimproved areas. In addition, some types of rotary wing aircraft are equipped with a hoist, and can accomplish pickup from a hover without landing.

349. Types of Missions

Army Aviation employed in search and rescue operations will normally be confined to a division sector, and may be restricted to the rescue of—

- a. Pilots forced down behind enemy lines.
- b. Small units and patrols isolated behind enemy lines.

350. Procedures for Initiating Search and Rescue

Based on information received in accordance with the standard operating procedure, the operations officer of the aviation unit receiving request for a rescue operation will take immediate action to—

- a. Dispatch observation aircraft to the rescue area to aid in the location of the object of rescue.
- b. Coordinate with fire support elements to place protective fires where required to isolate the individual(s) from the enemy.
- c. Coordinate with the Army operations center through the fire support coordination center to obtain necessary air protection and air defense artillery support.
- d. Alert personnel to ready necessary aircraft and equipment to perform the rescue.
- e. Perform necessary briefing of personnel who will perform the rescue.
- f. Alert medical personnel or have them accompany the rescue mission with necessary medical equipment.

351. Conduct of Search and Rescue

- a. During rescue operations, fire support elements will continue supporting fires until the rescue aircraft approaches the rescue area, at which time observers in other aircraft in the area will direct and

shift the supporting fires. Terrain and weather permitting, a smoke-screen may be put down to conceal rescue operations from the enemy.

b. The exact location of the individual(s) to be rescued may be pinpointed with pyrotechnic signals. Small units and patrols may indicate their exact location to the rescue aircraft by the use of smoke grenades. Orange color is used as an international distress signal.

c. Fighter protection is required in nearly all rescue operations. A joint scene-of-action frequency should be used for direct communication between the observation aircraft and fighter protection to direct airstrikes against enemy activity and further isolate the area of rescue for the enemy. If equipped with an FM transmitter, those being rescued should tune to previously established (SOI and SSI) emergency channel. This will enable searching aircraft equipped with radio AN/ARC-44 to home directly to the individual(s) or unit.

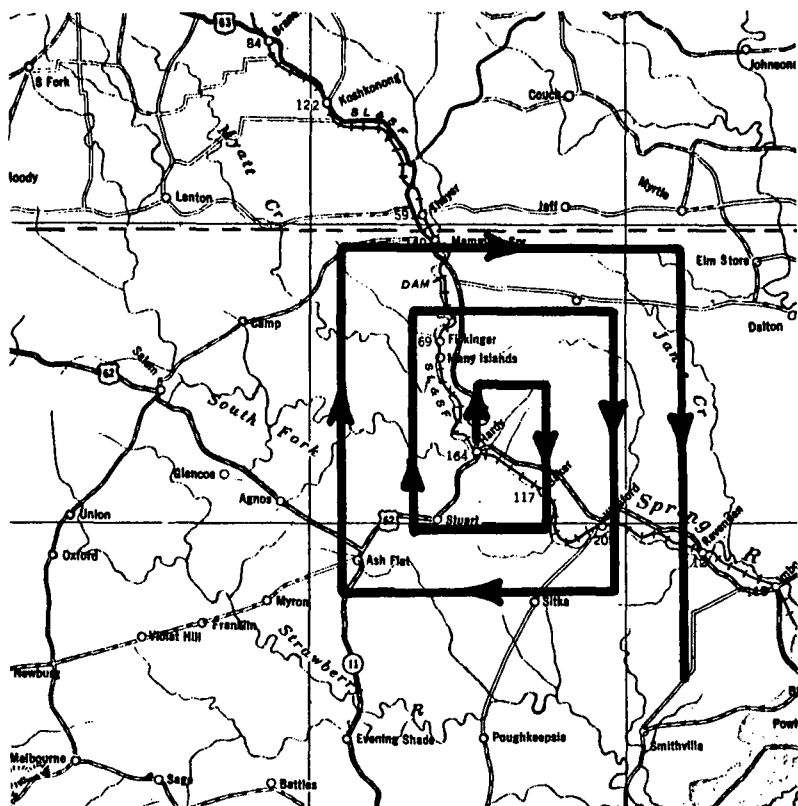


Figure 21. Square search pattern.

Section III. METHODS OF SEARCH

352. General

a. Search operations should be adapted to the existing conditions, such as weather and terrain, and should be flexible enough to permit changes which become necessary during the operation.

b. Search plans should be as simple as practicable since navigation difficulties increase if the plan requires the flying of numerous compass courses during the mission.

c. Aviation engaged in search missions usually operates in single aircraft within assigned subareas or along designated courses, the whole operation being coordinated to insure coverage of the area to be searched. When the number of available aircraft is insufficient for effective search of the area, a general search of the entire area as thoroughly as possible is better as a rule than a detailed search of a portion believed to be critical.

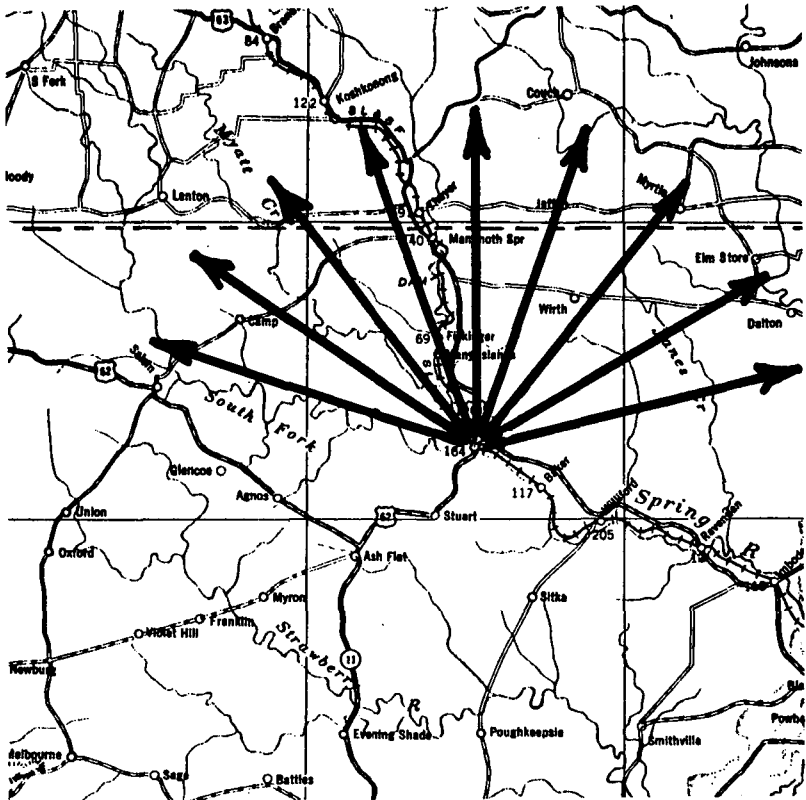


Figure 22. Radial search pattern.

353. Square Search Pattern

A square search pattern (fig. 21) is most adaptable to a tactical situation, and is conducted as follows: (1) Start from any point in the search area and fly approximately 1 mile in a given direction; (2) turn 90° and fly the same distance; then (3) make another 90° turn in the same direction as the first turn and fly twice the distance (approximately 2 miles) before making the third 90° turn.

Note. The distance is increased on each second leg of the pattern to expand the area of search.

354. Radial Search Pattern

The radial search pattern is a method wherein several aircraft leave a common point and fan out radially (fig. 22). Radial search can be employed by a larger number of short-range aircraft operating from a single base. Since all aircraft leave their point of origin at the same time, equal coverage is obtained in all radial directions of the search in approximately the same elapsed time. How-

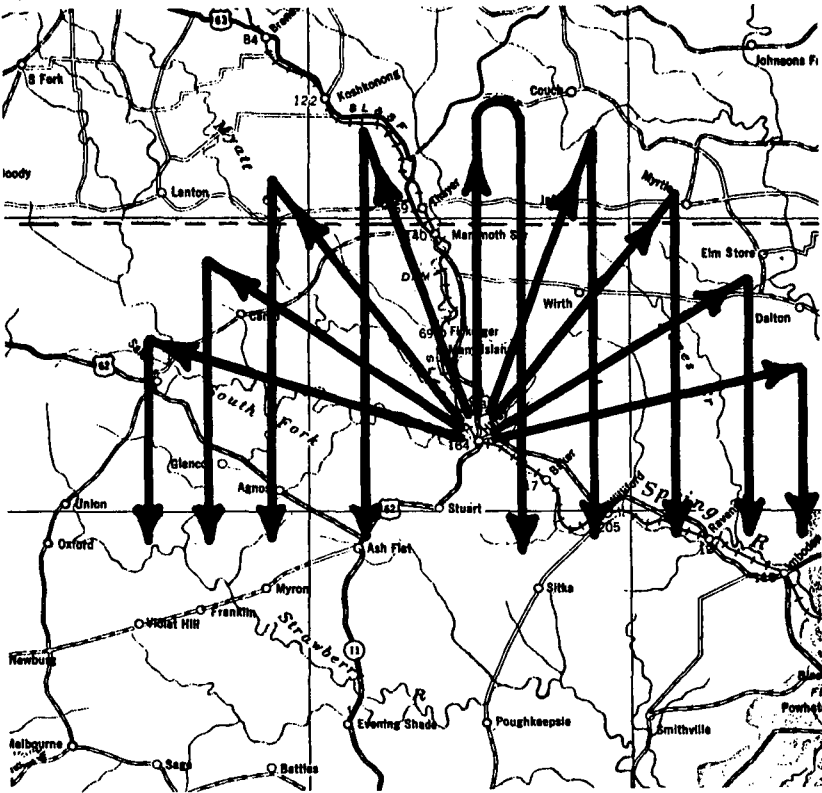


Figure 23. Radial search followed by parallel track.

retraced his outward course. This form of search provides, in addition to coverage at the outer limit, double coverage of the inner area by return convergence of the searching aircraft (fig. 24).

355. Parallel Search Pattern

The parallel search pattern (fig. 25) is formed by several aircraft departing from a starting line at prescribed space intervals, all aircraft routes being maintained along the same compass heading over the area to be searched. Parallel search provides equal coverage by uniform spacing and routing of the aircraft. For parallel search, the aircraft are flown from their operating bases to initial positions along the edge of the area to be searched. Normally the aircraft are spaced at a distance equal to twice the radius of visibility or less, depending on the degree of concentration desired and to offset possible changes in visibility. Orders for the search pattern should be issued well in advance of the time the search is to be started. Last minute changes of orders should be avoided. If a

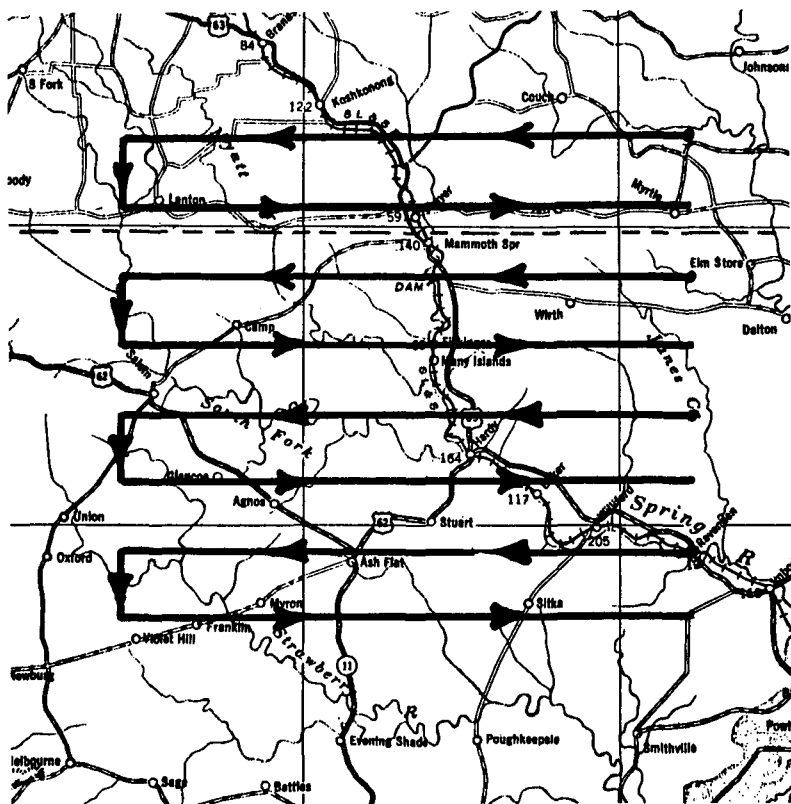


Figure 25. Parallel search pattern.

group of aircraft is to search and one drops out shortly before the mission is to be flown, it is usually preferable to continue with the search as originally planned rather than attempt readjustment of the complete search plan. Maximum search distance from the starting line is determined by the operating radius of the aircraft; minimum distance is determined by the requirements of the mission. Normally the aircraft will (1) proceed on course to a predetermined spot, (2) fly 90° from the original track for a distance of one-half the radius of visibility, then (3) return parallel to their original track (fig. 25).

356. S-Turn Search Pattern

The S-turn search proceeds down a road or given path as shown in figure 26. This type search is beneficial when aircraft availability is limited, visibility conditions are poor, and the travel route of the object of search is known.

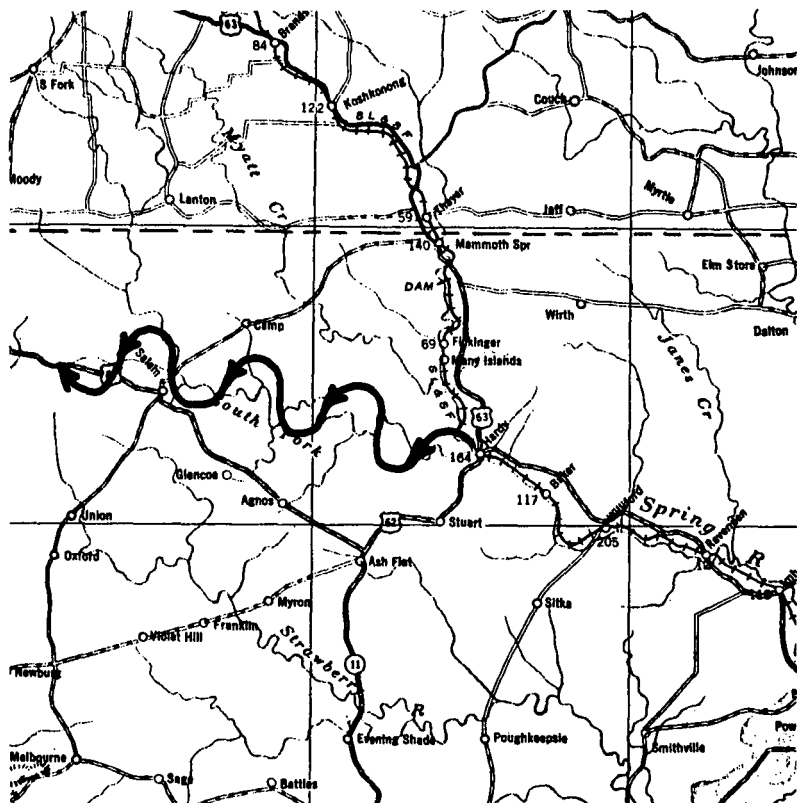


Figure 26. S-turn search pattern.

CHAPTER 19

CRASH RESCUE AND FIREFIGHTING PROCEDURES

Section I. ORGANIZATION AND TRAINING

357. General

Crash-rescue personnel must be prepared for immediate and effective action to neutralize all potential dangers which may result from aircraft accidents. Personnel must understand the nature of all types of fires and the most effective extinguishing agents to be employed therefor. The unit aviation officer is responsible for the equipment, organization, and training of crash-rescue teams within his unit. For a complete discussion of basic preparatory measures, duties, and operating procedures essential to activate all emergency crash firefighting and rescue services and associated supported activities, see AR 95-50-1.

358. Organization of Crash-Rescue Teams

Personnel strength and equipment of a crash-rescue team are determined by the size of the airfield and the frequency of traffic. To provide flexibility of operation, all unit personnel should be adequately trained to fulfill the duties of any member of the crash-rescue team; however, certain key personnel should always be included. These are:

- a. Firefighting specialist.*
- b. Airframe specialist.*
- c. First aid specialist.*

359. Training Scope of Crash-Rescue Personnel

- a. Firefighting Specialist.*
 - (1) Characteristics and effects of class fires.
 - (2) Characteristics and effects of extinguishing agents.
 - (3) Selection and application of extinguishing agents.
- b. Airframe Specialist.*
 - (1) Electrical system of all Army aircraft.
 - (2) Fuel system of all Army aircraft.
 - (3) Cutaway points of all aircraft airframes.

c. First Aid Specialist.

- (1) Practical application of immediate first aid.
- (2) Treatment of burns, cuts, and abrasions.
- (3) Splinting of broken limbs.

360. Equipment Requirements

All units are authorized certain items in unit tables of equipment; however, it is necessary at times to improvise and augment equipment for use by unit crash-rescue teams. The following items are listed as an equipment guide for unit commanders:

- a.* Vehicle (1/4-ton or 3/4-ton) (TOE).
- b.* Crash-rescue kit (TOE).
- c.* Fire extinguisher.
 - (1) Carbon tetrachloride (each aircraft).
 - (2) Foam or CO₂ extinguishers (engineer equipment).
 - (3) Blankets, vehicle tops, tarpaulins (salvage).
 - (4) First aid kit.
 - (5) Emergency communications system or warning device.

361. Unit Training of Crash-Rescue Team

A sustained training program will be initiated by the aviation officer to establish and maintain a high degree of unit proficiency in crash-rescue operations. Installation fire marshals or local engineer units and medical facilities will provide technical assistance to the aviation officer in this work. If operational requirements permit, on-the-job training can be arranged with these units to insure adequate training of aviation personnel.

Section II. THE CRASH-RESCUE PLAN

362. Operational Procedures

Six basic factors to be considered in crash-rescue operations are:

a. Protection of Crash Crew. Personnel involved in rescuing occupants of crashed aircraft and fighting resultant fires must be adequately protected. The success of their mission depends upon adequate training and available equipment. The basic concept of firefighting stresses the importance of operating as a team, with each member supporting or covering the other for protection against unexpected fires. The V-formation is most effective in approaching a crashed aircraft. In this manner, any unforeseen fires caused by flashbacks or scattered combustible materials can be quickly neutralized by the closest team member.

b. Protection of Aircraft Crew. If fire has not broken out by the time rescue operations begin, precautions should be taken to

prevent its starting. All electrical switches should be turned off immediately. Crew members should be removed as quickly as possible. If fire has already started, efforts to combat it should be directed toward expediting removal of occupants.

c. Confinement of Fire. To insure the success of rescue operations, every effort should be made to confine the fire to a small area for quick neutralization.

d. Wind Direction. Whenever possible, rescue and firefighting operations should be conducted from an upward position to lessen intensity of heat, density of smoke, and danger of vapors. If no fire exists, rescue operations should still be conducted from an upward position as a precaution against delayed flash fires.

e. Flow of Vapors and Fluids. When terrain and wind direction permit, firefighting equipment should be parked on ground higher than the crash area. Water and other liquids used in fighting the fire will flow toward lower ground and may mire the firefighting equipment. Gasoline vapors, being heavier than air, will likewise flow toward low ground, increasing the danger of flashback. If wind direction prohibits parking on high ground, equipment must be parked on as firm a surface as possible and at a maximum effective distance from the aircraft.

f. Alertness for the Unexpected. Crash personnel must be constantly alert for a sudden change in wind direction, the outbreak of fire in an unexpected area, or any other unforeseen occurrence. They should avoid obstructions which might trap them in the event of these developments.

363. Operational Duties

In addition to the six basic factors listed above, an effective crash-rescue plan must incorporate the following:

a. Delineation of Duties. Crash-rescue personnel must have their duties clearly outlined. Responsibilities must be unmistakably fixed in order to preserve order and prevent duplication of effort.

b. Elimination of Fire Hazards. All gasoline spills and other flammable materials should be blanketed and/or removed from the crash area.

c. Application of First Aid. In addition to administering first aid, a definite plan should be established to accomplish the expeditious evacuation of the injured to the nearest medical facility.

d. Use of Guards. The presence of spectators in the vicinity of the crash hampers rescue operations and endangers the lives of the spectators. The aircraft must continue to be kept under guard after rescue operations are terminated until the aircraft accident investigator has had an opportunity to inspect it.

PART FIVE

SERVICE AND SUPPORT

CHAPTER 20

AVIATION MEDICINE

364. General

a. Aviation medicine is concerned with the study, prevention, or alleviation of diseases or other bodily ailments arising from conditions produced by aviation.

b. Commanders, aviators, and other individuals concerned with Army Aviation should be made to realize the importance of aviation medicine. Successful employment of Army Aviation depends upon the proper understanding and application of this subject.

365. Training

Army Aviation medical officers provide for the health and welfare of ground operating personnel as well as aviators. These officers provide general medical care with moderate specialization in the fields of eye, ear, nose, and throat; neuropsychiatry; and preventive medicine.

366. Duties and Responsibilities

Army Aviation medical officers, upon completion of training, are assigned to appropriate TOE and TD units to perform the following functions:

a. Selection of flying applicants by medical examinations.

b. Clinical care of flying personnel with consideration for the specific problems inherent to flying.

c. Initiation of preventive "Care of the Flyer" program to preserve maximum individual and unit efficiency.

d. Advice to responsible commanders and boards of officers concerning medical aspects of aviation problems.

e. Development of improved policies and procedures relative to medical functions, concerning the utilization of flying personnel, aircraft, and related air equipment.

f. Advise the unit aviation commander on the medical aspects of crash-rescue operations and policies.

367. Responsibilities of Aviators

The primary responsibility of the Army aviator in combat is the successful accomplishment of his mission; while in noncombat situations, he is responsible for his passengers' safety as well as his own. It is the personal responsibility of each aviator to perform flying duty only when physically able. Standards of physical fitness pertinent to flying are set forth in AR 40-110. Other responsibilities are:

- a. An annual medical examination for flying to be accomplished within 30 days preceding or following the aviator's birthday.
- b. Participation in a recognized form of physical training to prepare for undue stresses such as parachuting and high G work.
- c. Reporting all injuries and illnesses to the flight surgeon.
- d. Abstaining from self-treatment or consultation with other physicians for fear of grounding by the flight surgeon.

368. Responsibilities of Commanders

The commander's responsibility for the health of his unit requires that he rely upon the qualifications of medical personnel assigned. These medical officers have received specialized training in aviation medicine. The major responsibilities of the commander are:

- a. To insure that medical facilities and services of the flight surgeon are available to aviators.
- b. To insure that all aviators are participating in some form of organized athletics.
- c. To insure proper utilization of aviators within the command.

369. Medical and Psychological Aspects of Flying

In the interest of health and safety, commanders and aviators should be aware of certain basic medical aspects of flying. Among the most important are:

a. Oxygen Conditions.

- (1) *Hypoxia.* Hypoxia may be caused by an insufficient amount of oxygen in the air being breathed, or by the inability of bodily tissues to absorb oxygen, as under decreasing pressures at high altitudes, and may result in loss of consciousness. Hypoxia is generally associated with high-altitude flying. In aircraft not equipped with portable oxygen equipment, it is necessary to drop to low altitudes.
- (2) *Hyperoxygenation.* Hyperoxygenation exists when there is an excess of oxygen in the body above that normally exist-

ing at sea level. This condition can be either induced or caused by use of faulty oxygen equipment. Induced hyperoxygenation may be caused by extreme cases of anxiety or by rapid breathing for an extended period of time. Hyperoxygenation may result in loss of consciousness and can be remedied by decreasing the breathing rate.

b. Airsickness. Airsickness is difficult to avoid completely in military operations since combat aircraft must be flown regardless of turbulence. However, the following measures may be taken to prevent or control symptoms of airsickness:

- (1) Gradually introduce the passenger to the motion of the aircraft, especially in aerobatics.
- (2) Select the most favorable flight route to avoid turbulence.
- (3) Avoid violent and unnecessary maneuvers.
- (4) Choose a position in the aircraft as near the center of gravity as possible.
- (5) Ride with the eye closed during turbulent conditions. (Shifting visual references causes increased susceptibility.)
- (6) Avoid strong odors or hot stuffy air in the aircraft.
- (7) Avoid overindulgence in use of food or alcohol prior to flight.
- (8) Fix gaze on a stable visual reference outside the aircraft, preferably the horizon.

c. Earache. Earache is a common ailment of passengers who have had little or no flying experience. Rapid descents, characterized by sudden changes in pressure, are generally the cause of earaches. The obvious preventive measure is to make gentle descents whenever possible. Pressure in the ear may be alleviated by chewing gum, swallowing, or by holding the nostrils closed while attempting forcibly to exhale.

d. Anxiety (Fear of Flying). Passengers rarely complain of anxiety or fear, mainly because they regard it as an expression of cowardice. However, most of their fears are unwarranted, and a brief explanation will often suffice to relieve their anxiety. The best solution to the problem lies in a reassuring briefing by the aviator coupled with a reasonably gradual indoctrination.

CHAPTER 21

AVIATION SUPPLY

Section I. GENERAL

370. Aviation Technical Supply

a. The purpose of aviation technical supply (i.e., that supply, exclusive of TOE items, peculiar to aviation) is to provide for issue of repair parts and replacement items necessary to maintain Army aircraft. The technical supply section of a third or fourth echelon maintenance facility supplies or processes all Transportation air items required to support aviation units. Items of equipment other than Transportation air items are requisitioned from the responsible technical service through the appropriate technical service representative; e.g., radio equipment would be requisitioned from Signal Corps Supply Depots through the appropriate signal officer. Transportation air items are of two types:

- (1) *Principal items.* Aircraft (trainer and flight simulator).
- (2) *Secondary items.* Any item (including end item component and repair parts) which has not been classified as a principal item.

b. Technical supply items are requisitioned by organizations in the same manner as unit supply items.

371. Channels of Supply

a. Zone of Interior. See AR 715-, 725-, 750-, and 755-series.

b. Oversea Supply Support.

- (1) The oversea commands establish depot stock levels. Oversea depots are responsible for requisitioning from designated Zone of Interior depots as necessary to maintain stock levels, and provide supply support to stations, units, and activities in filling requisitions (fig. 27).
- (2) Oversea supply support is represented in figure 28. The fourth echelon maintenance activity establishes the station stock objective for an item; requisitions it from the depot or procures it in accordance with AR 715-8; receives and stores it; and subsequently issues the item to the third echelon maintenance activity for use or reissue to Army

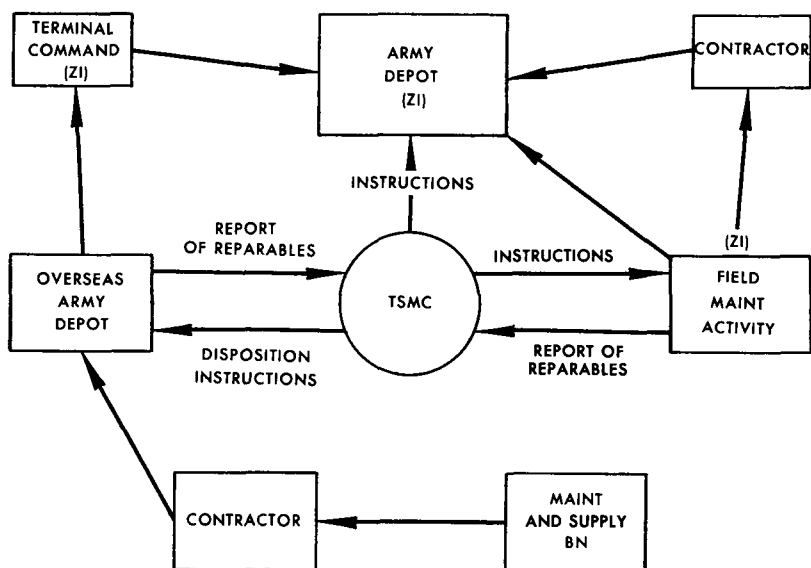


Figure 27. Flow of reparable.

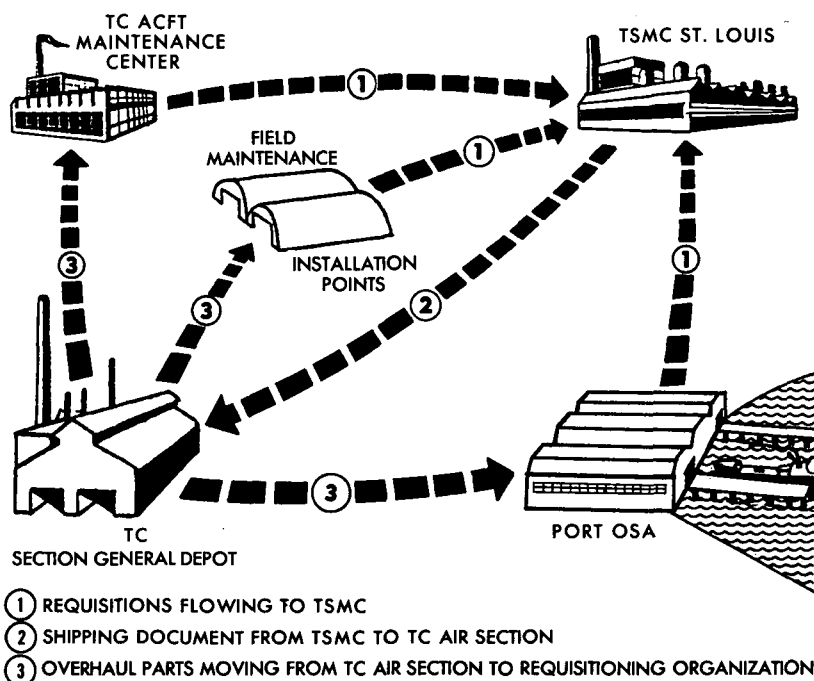


Figure 28. Flow of requisitions and supplies.

Aviation activities performing organizational maintenance. Repairable items are repaired at all levels, within repair capability, and returned to serviceable stocks. Repairable

items beyond the capability of the transportation Army aircraft heavy maintenance and supply (TAAHM&S) company are sent to depot for maintenance and return to serviceable stock.

372. Classification of Aviation Supplies

a. General Classification. All Army air items are classified as principal items (aircraft), major secondary items (those that have not been classified as principal but require the same degree of control), or secondary items (all other items including end items that have not been classified as primary items).

- (1) Authorization tables (TOE, EML, TA, circulars, approved projects, and letters of special authority) afford requisitioning authority for principal items.
- (2) Maintenance float stock of Army aircraft are held by third and fourth echelon Transportation Corps aviation activities to maintain supported units at their authorized strength. The quantity of aircraft authorized to be held by the maintenance activities is in direct proportion to the number and type of aircraft being supported (AR 711-16) by the field maintenance activity.
- (3) Secondary items are stocked at Transportation Corps sections of general depots and shipped, when requested, to Zone of Interior field maintenance shops and oversea depots to maintain their operating stock levels of serviceable air items. These maintenance units issue equipment to using organizations as requested.

b. Air Force Classification. Air Force supply identification numbers are being used until their conversion to federal stock numbers. The Air Force system of identification consists of a universal number for stocking and ordering, as well as for procuring. The universal number includes the stock number, which consists of an Air Force property classification symbol, a manufacturer's part number, or a serial number assigned to the manufacturer, and a weapons-system coding. The nomenclature may be complete, abridged, or consist only of a noun. The type classification includes type and status, classification for control of supplies, unit of issue, and other data.

c. Federal Supply Classification. The Federal Supply Classification (FSC) utilizes a four-digit coding structure. The first two digits identify the group, and the last two, the code number. The primary application of the FSC class code number is in the federal stock number (FSN) which consists of the applicable FSC class code number plus the seven-digit federal item identification number.

d. Stock Classification.

- (1) *Classification code.* This is a number assigned an item for the purpose of category grouping of closely related items.
- (2) *Serial number.* This number is assigned to arrange a category in alphabetical sequence according to item description.
- (3) *Part number.* A part number is assigned by the design manufacturer. (For further information regarding the Air Force stock numbering system, refer to T.O. S-1-3.)

373. Expendable (Nonreparable) Items

Expendable items are those consumed in use or in the repair or completion of other articles. Classification of reparable items as expendable does not prohibit their reclamation for repair when disassembling other articles for repair. Classification of repair parts as nonexpendable may prohibit stockage in organizational supply and may require more stringent accounting procedures than for expendable items.

374. Nonexpendable (Reparable) Items

Nonexpendable items are those not consumed in use or which retain original identity. They flow continuously through the supply pipeline: as serviceable, from depot to station, to using activity; as reparable, from using activity to the field maintenance activity (for repair or forwarding to depot for repair). In either case, the nonexpendable item is condemned or repaired. (For disposition at station, see AR 755-7.) Upon removal from an aircraft, nonexpendable items are repaired by organizational maintenance or submitted to the Army field maintenance activity for repair and return to stock, condemnation, and salvage if nonreparable, or shipment to the proper depot.

Section II. SUPPLY PROCEDURES

375. General

The primary function of the aviation technical supply section receives, records, stores, and issues replacement parts for the proper maintenance of Transportation air items.

a. Source of Supply. AR 725-750 designates the source of supply for Transportation Corps supplies and equipment including Transportation air items.

b. Replenishment of Stocks. Organizational stocks are replenished so as to maintain stock levels prescribed by appropriate depots or stock control points. Requisitions will contain only those items on the authorized stocklists and will be for the quantity required to bring the total on hand and on order to meet the requisitioning

objective. In this computation, all available supply assets of the installation will be considered, including reparable parts.

376. Stock Record Account

a. Purpose. The stock record account is a basic formal record that shows by items the receipt and disposal of property, the balance on hand, and such other identifying or stock control data as may be required by proper authority.

b. Stock Record Account Numbers. AR 735-5 requires that a serial number will be assigned to each stock record account to permit ready identification and prevent unauthorized stock record accounts. The stock record account serial number will be placed on all requisitions, receiving reports, and purchase orders.

c. Stock Accounting Cards. A separate stock accounting card will be established for each authorized item having a separate stock number and description, or for each item with a balance on hand. Separate stock accounting cards will not be maintained for each serial numbered item, but items with serial number identification will be so identified on the voucher when issued on loan, or when issued and accounted for on the station or company property book.

d. Voucher to Stock Record Account. Vouchers evidence a transaction in a property account and are normally of three types:

- (1) *Debit* vouchers list articles to be picked up to increase a balance on hand.
- (2) *Credit* vouchers list articles to be dropped from a property account to decrease the balance on hand.
- (3) *Adjustment* vouchers are used to bring the balance on hand as shown on the property account into agreement with the quantities actually on hand.

e. Voucher Identification. Prior to posting, vouchers will be stamped or otherwise clearly marked to indicate the nature of transaction as "Debit," "Credit," or "Inventory Adjustment Report," as appropriate.

f. Voucher Numbers. Vouchers to each stock record account will be numbered serially for each fiscal year.

g. Stock Record. The stock record consists of the stock accounting card (*c* above), title insert, demand data card, due-in card, and due-out card for an individual item, all filed in a single pocket.

h. Posting of Stock Accounting Card. Posting of stock accounting cards will be kept current to reflect accurately the quantities of stock on hand.

377. Inventories

Inventories systematically and thoroughly performed furnish accurate accounts of stocks on hand. Organizational stocks are normally inventoried once every 90 days.

378. Aircraft Out of Commission for Parts (AOCP)

An AOCP requisition denotes the emergency type used when all routine maintenance has been accomplished on an aircraft and needed part or parts prevents the aircraft from flying (AR 700-150). AOCP requisitions will be given the highest priority and forwarded by electrical means.

379. Return of Unserviceable Items

All unserviceable reparable items are exchanged for serviceable items.

380. Reclamation and Salvage

a. All serviceable air items eventually become unserviceable as a result of damage, failure, or normal wear. If items can be economically restored to their original degree of serviceability, the overall Army Aviation supply burden is relieved, and the stock level of serviceable items increased. Inspection of unserviceable items is the first step in reclamation and salvage. Items are restored to serviceability by the lowest level maintenance activity capable of performing the work economically without interference in accomplishment of its primary mission.

b. Damaged aircraft, or their major components, are processed as stated above after disassembly to the smallest integral units and reparability classification of these units. Disposition of unserviceable aircraft, governed by AR 750-1500-4, is necessary to avoid uneconomic expenditures of manpower and funds in restoring aircraft to airworthy condition. When aircraft are beyond repair allowances, disposition instructions will be requested by means of DA Form 598. Aircraft losses are reported on DA Form 1352 (AR 710-1500-8).

381. Issue and Turn-In Slip, DA Form 1546

DA Form 1546 is the requisition form for using units and organizations requisitioning repair parts needed on a daily basis. This requisition flows through the supply channel for single-line items. As part of the processing operation at the point of supply, a preprinted or pretyped issue and turn-in slip is prepared and forwarded to the using organization with the shipping copy of the original issue and turn-in slip. The units are thereby informed of the supply action taken within two working days after making the original request.

382. Due-Out Release, DA Form 1544

The due-out release form is a three-part bound form prepared to facilitate the delivery of repair parts upon which due-outs have been established at the supply point.

CHAPTER 22

AVIATION MAINTENANCE

Section I. GENERAL

383. Maintenance Categories

As outlined in AR 750-5, maintenance operations are classified into categories according to the frequency, magnitude, and degree of technical skill required. Jobs are allocated to using organizations and to technical service organizations in accordance with the principles given in paragraph 384. The categories of maintenance are organizational maintenance, field maintenance, and depot maintenance.

a. The allocation of functions to the three categories of maintenance is covered in general in AR 750-6 and specifically for each major item in the appropriate maintenance allocation chart.

b. Major commanders will give full consideration to having their respective organizational and field maintenance responsibilities performed by commercial contract or cross-servicing agreements when maintenance requirements exceed the capacity of available Government-owned or Government-operated facilities, or when the cost of using these facilities or of making additional facilities available is uneconomical.

c. Army maintenance usage codes (AR 750-5) are as follows:

O—Organizational maintenance, first and second echelon.

F—Field maintenance, third echelon.

H—Field maintenance, fourth echelon.

D—Depot maintenance, fifth echelon.

384. Principles

a. Maintenance of Army aircraft and allied equipment is performed in the manner and at the maintenance level that will best accomplish the earliest return of material to the using organization. Corollary principles are:

- (1) Maintenance is accomplished by the lowest echelon consistent with—the scope of maintenance authorized; the availability of parts, tools, and special repair equipment;

the capabilities of personnel; time available; and the tactical situation.

- (2) No echelon will perform higher echelon maintenance at the expense of its own prescribed maintenance. Any echelon may perform lower echelon maintenance.
- (3) Aircraft requiring higher echelon maintenance are promptly evacuated to the next higher echelon.
- (4) Transportation maintenance units salvage, reclaim, and evacuate major items, subassemblies, assemblies, and parts to the maximum extent possible.

b. Each echelon of maintenance has the repair parts, tools, special repair equipment, and trained personnel required to perform its authorized level of maintenance. Reasonable time, space, and working conditions must be provided for completion of the assigned maintenance task.

c. Reports will be submitted to the appropriate commander of any abuse of equipment resulting from maintenance performed by a unit above that echelon authorized in its mission.

d. The equipment of other technical services may be maintained by transportation maintenance units, at the discretion of the responsible commander, when an overall increase in efficiency will result from such cross-servicing arrangements.

385. Responsibility

Commanding officers will insure that all equipment issued or assigned to their command is properly maintained in a serviceable condition, and that equipment is properly cared for and used. This includes the responsibility for—

a. *Preventive Maintenance.* Correction of small deficiencies through early and thorough preventive maintenance will prevent the development of deficiencies requiring major repair. Close and accurate methods for checks on quality and standards of all echelons of maintenance should be developed with the thought of improving the standards of maintenance rather than retaining the standards at the existing level. Attempts to raise maintenance standards at all levels should be a continuing function within all units. Some common abuses of the preventive maintenance system are—

- (1) Improper, careless, or negligent use of operation of material.
- (2) Lack of lubrication, overlubrication, or use of unauthorized lubricants.
- (3) Lack of adequate inspections.
- (4) Deferred maintenance, including lack of proper servicing and adjustments.

- (5) The attempt to repair by unqualified personnel or by use of improper or inadequate tools and equipment.

b. Work Performance. A high standard of work performance serves as an objective for supervisors and is a yardstick for evaluating the accomplishments of any maintenance activity. Adverse working conditions resulting from weather, location, or enemy action will be taken into account in arriving at an adjusted standard of work performance. A standard of work performance is qualitative as well as quantitative and quality of workmanship will not be subordinated to the quantitative requirement.

c. Equipment. Direct responsibility is attached to individuals having equipment entrusted to their personal use or to use by their subordinates; i.e., either personal or supervisory responsibility. An appropriate example of supervisory responsibility is that of the organizational aircraft maintenance officer whose duties are to—

- (1) Supervise the maintenance work performed by unit mechanics.
- (2) Insure that organizational maintenance is complete and in accordance with applicable technical publications.
- (3) Insure that organizational maintenance does not exceed first and second echelons of maintenance or third echelon maintenance authorized by higher headquarters.
- (4) Supervise or coordinate unit technical supply to insure that spare parts are stocked and that requirements for spare parts and supplies are anticipated.
- (5) Maintain liaison with supporting field maintenance units for advice and backup maintenance support.
- (6) Be alert to current policies concerning maintenance activities.
- (7) Prepare and submit required maintenance reports.
- (8) Advise the unit commanding officer on maintenance activities affecting aircraft availability.
- (9) Coordinate the scheduling of aircraft with the unit operations officer to insure that aircraft are available when needed but with sufficient time allowed for maintenance.
- (10) Coordinate the requirements for additional mechanics with the unit personnel officer.
- (11) Supervise the supply, use, and maintenance of tools and equipment used in maintenance activities.

Section II. MAINTENANCE CATEGORY RESPONSIBILITIES

386. Organizational Maintenance

Organizational maintenance is that maintenance which is authorized for, performed by, and the responsibility of a using or-

ganization on its own equipment. This maintenance consists normally of inspecting, cleaning, servicing, preserving, lubricating, and adjusting as required. It may also consist of minor parts replacement not requiring highly technical skills. Organizational maintenance usually incorporates the first and second echelons, as follows:

a. First echelon maintenance is that maintenance performed by the user, wearer, or operator of the equipment. It includes proper care, use, operation, cleaning, preservation, lubrication, and such adjustment, minor repairs, testing, and parts replacement as may be prescribed by pertinent technical publications or tool and parts lists.

b. Second echelon maintenance is that maintenance designated to be performed by specially trained personnel provided for that purpose in the using organization. Appropriate publications authorize additional tools, parts, supplies, test equipment, and skilled personnel for second echelon maintenance.

387. Field Maintenance

Field maintenance is that maintenance authorized and performed by designated maintenance units in direct support of the using organizations. Normally this category will be limited to maintenance consisting of replacement of unserviceable parts, subassemblies, or assemblies. Field maintenance usually incorporates the third and fourth echelons as follows:

a. Customarily, a third echelon unit provides maintenance support to a number of using organizations. In special cases, however, third echelon maintenance may be performed by maintenance units organic to the using unit. Third echelon organizations repair subassemblies, assemblies, and the overflow from the lower echelons of maintenance within limits imposed by specified authorization of tools, parts, and test equipment. They also support the lower echelons by providing technical assistance, mobile repair crews, and additional repair parts.

b. Fourth echelon maintenance is performed by units organized as semifixed or permanent shops. They serve lower echelons of maintenance within a specific geographical area. Fourth echelon maintenance may furnish mobile repair crews or reinforcing elements to lower maintenance echelons when required. The principal function of fourth echelon maintenance is to repair subassemblies, assemblies, and major items for return to the lower echelons for use or reissue.

c. AR 750-770 provides a list of installations in the continental United States at which transportation shops are located for the purpose of accomplishing field maintenance on Army aircraft.

These designated installations have attached or assigned shops based upon a table of distribution to provide field maintenance to the army units within their specified areas. TOE aircraft maintenance organizations are sometimes attached to these field maintenance shops and perform field maintenance in conjunction with their training. In oversea theaters the capabilities of these transportation corps field maintenance units will vary according to their size and composition and depending upon facilities and the equipment provided. To provide adequate support, the assigned mission of these units is clearly outlined by appropriate TOE or the army commander.

d. The primary functions of Transportation Corps field maintenance units are as follows:

- (1) To furnish Army aircraft field maintenance support (third and fourth echelon) for all organizations and stations located within the area of responsibility.
- (2) To provide Army aircraft maintenance support on a reimbursable basis, under the provisions of AR 130-400, for National Guard units located within their area of responsibility, when requested by state maintenance officers through the United States Property and Disbursing Officer (USP&DO).
- (3) To accomplish technical inspections of Army aircraft in accordance with AR 750-725.

e. Transportation Corps aircraft maintenance units provide third echelon direct maintenance support for all Army Aviation activities which are located in the corps and Army service area. Direct support (third echelon) field maintenance for all divisional aircraft is provided by a Transportation Corps aircraft maintenance unit organic to each division. Those aviation activities located in the Army service area will be provided direct maintenance and supply support by the Transportation Army Aircraft Maintenance Company or by the Transportation Army Aircraft General Support Maintenance and Supply Battalion, whichever is more practicable considering physical location.

f. The Transportation Army Aircraft Maintenance and Supply (General Support) is directly responsible for all backup supply and maintenance to direct support aircraft maintenance activities within its area of responsibility. The battalion performs fourth echelon maintenance for all Transportation air items assigned to a field army. It receives, stores, flight tests, and reissues all aircraft received from depot stock. It transmits equipment and aircraft to the Transportation Army Aircraft Depot Support Battalion for fifth echelon maintenance and overhaul, receiving aircraft and

allied equipment from the depot battalion, and storing such material or shipping it to Transportation Army aircraft direct support maintenance and supply units.

388. Depot Maintenance

Depot maintenance of Army aircraft and allied aircraft equipment is that maintenance required for the repair of material which requires major overhaul or complete rebuild of parts, subassemblies, assemblies, and/or the end item. Such maintenance is intended to augment stocks of serviceable equipment and to support lower levels of maintenance by use of more extensive shop equipment and personnel of higher technical skill. In the Army, depot maintenance embraces fifth, the highest, echelon of maintenance. Fifth echelon rebuilds major items, subassemblies, assemblies, parts, accessories, tools, and test equipment. It normally supports supply on a rebuild and return to stock basis. Fifth echelon operations are scheduled, employing production and assembly line maintenance methods whenever practicable.

a. Continental United States. The Army is responsible for depot maintenance and supply support of its aircraft. However, these operations are complex and this recently assigned responsibility is being assumed in phases. All depot maintenance in continental United States is being performed under contract with private industry or cross-servicing with the Air Force and/or Navy.

b. Overseas. Depot maintenance in major oversea commands will be accomplished initially by TD units augmented by civilian labor, by contracts, or by cross-servicing agreements. At a later date Transportation Corps TOE units will replace TD units. In those geographical areas where the Air Force is assigned logistic responsibilities (AR 700-40 and AFR 67-59), the Air Force will perform depot maintenance as requested by Department of the Army on a cross-servicing basis.

Section III. AIRCRAFT MAINTENANCE INSPECTIONS

389. Purpose of Aircraft Maintenance Inspections

Aircraft maintenance inspections serve the following purposes:

a. Insure that preventive maintenance services are effective in detecting and correcting failures of materiel before unserviceability results.

b. Determine the serviceability, completeness, and field readiness of transportation materiel in the hands of using units. Inspections are continued during combat to determine the need for materiel rehabilitation and replacement. Inspections conducted before op-

erations insure that equipment is ready for combat; after operations, inspections determine action required to restore combat effectiveness of equipment.

c. Develop teamwork between the using organization and supporting transportation maintenance units.

d. Assist in matters affecting transportation supply.

e. Provide instruction in administration and operation of organizational supply and maintenance.

f. Detect and analyze the most prevalent deficiencies in maintenance of materiel and submit detailed unsatisfactory equipment reports in order that the attention of the commanding officer, maintenance personnel, and design engineers may be directed toward specific improvement.

g. Anticipate unusual supply demands.

h. Evaluate relative efficiency of organizational maintenance in units of the command.

i. Determine deficiencies in training and permit appropriate recommendations for emphasis in the training of using units.

j. Record, periodically, the condition of transportation materiel in the hands of troops as a means of determining responsibility for unwarranted deterioration and abuse.

390. Types of Aircraft Inspections

All inspections of equipment are conducted under command authority; they are the means by which commanders at all echelons, acting within the scope of their command mission, determine the serviceability of equipment and the efficiency of maintenance. (See AR 750-8, AR 750-725, and DA TM appropriate to the aircraft concerned.)

CHAPTER 23

GROUND HANDLING AND MOORING

391. Fixed Wing Aircraft

a. Mooring. In mooring fixed wing aircraft, the parking brakes must be set and wheel chocks put in place. Mooring ropes will be affixed only to points specified in appropriate technical orders. A tail support device should be used for aircraft with tricycle landing gears.

b. Control Surface Locks. Ailerons, elevators, and flaps must be locked securely. Some aircraft have locking devices in the cockpit. For those not so equipped, control surfaces are locked by padded locking devices to which eye-catching safety streamers are attached. Ground handling and mooring are discussed in the dash-2 technical orders assigned to each aircraft.

c. Pitot Tubes. See paragraph 392c.

d. Manhandling. Pressure to move an aircraft by hand may be applied only at points designed to receive pushing and pulling forces. These points are specified in appropriate technical orders. No pressure should be applied to those delicately rigged or thinly covered surfaces plainly marked "No Push," "No Step," etc., on any aircraft.

e. Towing. When towing aircraft with conventional landing gear, a towbar designed to fit the tail wheel may be used. Some aircraft have towbar attaching points affixed to the landing gear. Aircraft with tricycle type landing gears may be towed, using a towbar attached to the nose wheel.

f. Ground Handling in High Winds. In gusty or high winds, taxiing aircraft must be escorted by ground personnel. "Spoilers" (devices to disrupt normal airflow) should be placed on the wings.

392. Rotary Wing Aircraft

a. Mooring. Rotary wing aircraft must be moored into the prevailing wind to prevent gusts from lifting the tail cone. The wheels should be chocked and the blades covered with specially designed canvas covers supplied with the aircraft, which are tied to specific points as designated in the appropriate technical order.

b. Control Surface Locks. A canvas web strap and a blade-securing block are used to prevent flapping or rotation of the main rotor blade while parked.

c. Pitot-Static Tube. Moisture condensation or dirt in the pitot-static tube would render several flight instruments inaccurate; therefore, it is extremely important that the unit be covered at the end of each day's flying. This cover should always be removed before takeoff so these instruments will function.

d. Manhandling. Great care must be exercised in manhandling rotary wing aircraft to assure that the surfaces are not damaged. Hand pressure may be applied only at points specified in appropriate technical orders.

e. Towing. Rotary wing aircraft may be towed with towbars designed for the particular aircraft and attached to the forward landing gear.

f. Ground Handling in High Winds. Rotary wing aircraft may be maneuvered on the ground in high winds without ground crew assistance or by means of dollies for skid-equipped aircraft.

393. Anchors and Ropes

a. Anchors. Several type mooring anchors are illustrated in figure 29. A mooring kit should always be carried in each aircraft.

b. Ropes. If mooring ropes are used, they should be at least one-half inch in diameter and made of hemp or nylon. They should be inspected frequently for signs of wear and replaced whenever their strength is questionable. In securing aircraft, ropes should be just tight enough to prevent bouncing of the aircraft in the event of a high wind. For detailed instructions on knots and splices, see TM 5-225.

394. Ground Operation of Fixed and Rotary Wing Aircraft

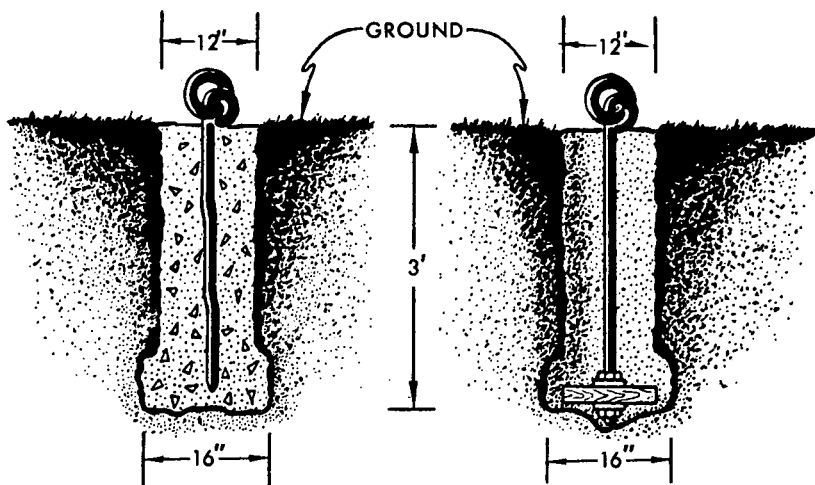
See AR 95-85 for regulations governing ground operation of fixed and rotary wing aircraft.

395. Servicing Aircraft

a. Aircraft will not be taxied closer than 100 feet to runways where other aircraft are landing or taking off, unless necessitated by terrain or when the operator is specifically directed to do so.

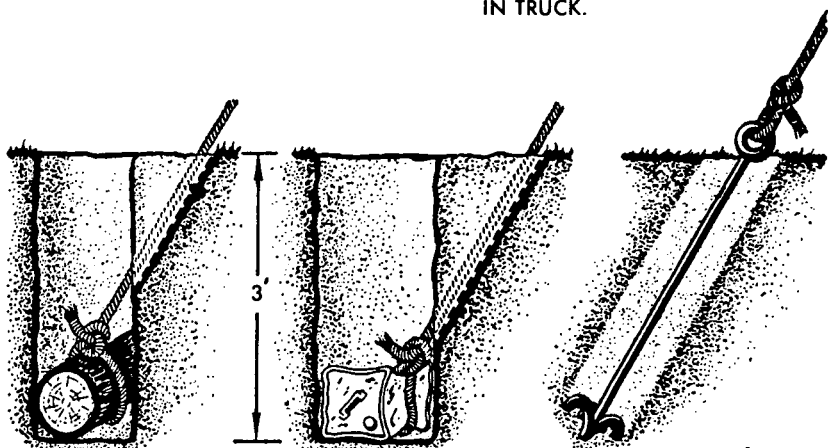
b. When an aircraft is maneuvered in close proximity to other aircraft, buildings, or other obstructions, and in gusty or high wind conditions, ground personnel will be stationed at each wingtip to insure adequate guidance.

c. When moving aircraft by hand, pressure for pushing, lifting, or turning will be applied only on struts adjacent to fuselage or wing connection, and on the tail lift handles. Personnel will not



IRON ROD WITH RING SET
IN CONCRETE, USED FOR
PERMANENT MOORING.

LONG EYE BOLT THROUGH
2"X 4" OR LARGER, BOARD.
SEMI-PERMANENT. MAY BE
CONSTRUCTED AND CARRIED
IN TRUCK.



DEADMAN:

LOG 6" DIAMETER OR
LARGER. ROPE, CABLE,
OR CHAIN ATTACHED.
(ROPE MAY ROT IN
MOIST SOIL)

DEADMAN:

5-GALLON CAN
CRUSHED SLIGHTLY IN
CENTER TO PREVENT
ROPE FROM SLIDING
OFF: GOOD IN LOOSE
OR SANDY SOIL. FILL
CAN WITH DIRT OR
SAND.

PORTABLE MOORING
KIT FURNISHED WITH
AIRPLANE. FAIRLY
DEPENDABLE EXCEPT IN
LOOSE OR SANDY SOIL.
(SAME SLANT AS ROPE)

Figure 29. Types of anchors.

lean or exert pressure against wing or empennage surfaces, wing-tips, or surface trailing edges in any manner which may result in structural strain.

d. No person will ride on the wings, empennage, or other external part of an aircraft while the aircraft is being taxied.

e. Standard procedure for servicing aircraft should be prescribed by each unit aviation officer. The ground crew must be properly trained in the use of engine oils and fuels, capacity of oil and fuel tanks, and safety precautions to be observed. Caution must be exercised in filling fuel tanks to avoid breaking the tank necks.

f. Safety precautions during refueling operations include:

- (1) No smoking within 50 feet of any aircraft, gas truck, or gas dump.
- (2) Grounding (bonding) of refueling apparatus to lessen the danger of fire resulting from static electricity.

396. Hand Signals and Taxiing

a. Hand Signals. The system of hand signals shown in appendix XIV are agreed upon by United States Army, United States Navy, United States Air Force, United States Marine Corps, Royal Air Force, and Royal Navy. They will be used by all ground and air personnel (civilian and military) to direct and control the operation and movement of aircraft on the ground.

b. Operation at Other Than Army Installations. Army personnel operating aircraft from an installation under other than Army control will also comply with appropriate additional safety regulations prescribed by that installation commander.

APPENDIX I

REFERENCES

DA Pam 108-1.....	Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.
DA Pam 310-series.....	Military Publications Indexes.
AR 40-110.....	Standards of Medical Examinations for Flying.
AR 40-574.....	Insect Control by Aircraft.
SR 55-720-1.....	Preparation for Oversea Movement of Units (POM).
AR 59-107.....	Air Traffic Coordinating Officers.
AR 59-109.....	Flight Priority of Nontactical Military Aircraft Operating During a Military Emergency.
AR 66-5.....	Courier Service: Administrative and Operational Procedures.
AR 66-10.....	Instructions for Designated Officer Couriers to Convey or Destroy Armed Forces Courier Service Material.
AR 95-series.....	(Aviation.)
AR 130-400.....	Logistical Policies for Support.
AR 220-50.....	Regiments—General Provisions.
AR 220-60.....	Battalions—General Provisions.
AR 220-70.....	Companies—General Provisions.
AR 320-5.....	Dictionary of United States Army Terms.
AR 320-50.....	Authorized Abbreviations and Brevity Codes.
AR 385-40.....	Accident Reporting and Records.
SR 700-40-10.....	Supply of Common Items to Army and Air Force in Oversea Commands.
AR 710-1500-8.....	Army Aircraft Inventory, Status, and Flying Time.
AR 711-16.....	Installation Stock Control and Supply Procedures.
AR 715-series.....	(Procurement.)
AR 725-series.....	(Issue of Supplies and Equipment.)
AR 735-5.....	Property Accountability: General Principles and Policies.
AR 750-series.....	(Maintenance of Supplies and Equipment.)
AR 755-series.....	(Disposal of Supplies and Equipment.)

DA Cir 310-55.....	Routes of Communication.
FM 5-20E.....	Camouflage of Aircraft on the Ground and Airdromes.
FM 5-34.....	Engineer Field Data.
FM 6-40.....	Field Artillery Gunnery.
FM 6-120.....	The Field Artillery Observation Battalion and Batteries.
FM 6-135.....	Adjustment of Artillery Fire by the Combat Soldier.
FM 7-100.....	The Infantry Division.
FM 11-series.....	(Signal.)
FM 17-100.....	Armored Division and Combat Command.
FM 21-5.....	Military Training.
FM 21-6.....	Techniques of Military Instruction.
FM 21-11.....	First Aid for Soldiers.
FM 21-20.....	Physical Training.
FM 21-26.....	Map Reading.
FM 21-30.....	Military Symbols.
FM 21-40.....	Small Unit Procedures in Atomic, Biological, and Chemical Warfare.
FM 21-41.....	Soldier's Handbook for Nuclear, Biological, and Chemical Warfare.
FM 21-60.....	Visual Signals.
FM 21-75.....	Combat Training of the Individual Soldier and Patrolling.
FM 21-76.....	Survival.
DA Cir 310-51.....	Signal Communications.
FM 24-18.....	Field Radio Techniques.
FM 24-20.....	Field-wire Techniques.
FM 41-5.....	United States Army and Navy Manual of Civil Affairs/Military Government.
FM 27-10.....	The Law of Land Warfare.
FM 30-series.....	(Military Intelligence.)
FM 31-series.....	(Special Operations.)
FM 33-5.....	Psychological Warfare Operations.
FM 41-15.....	Civil Affairs/Military Government Units.
FM 44-1.....	Antiaircraft Artillery Employment.
FM 55-6.....	Transportation Services in Theaters of Operation.
FM 57-20.....	Airborne Techniques for Divisional Units.
FM 57-30.....	Airborne Operations.
FM 57-35.....	Army Transport Aviation—Combat Operations.
FM 60-series.....	(Amphibious.)
FM 72-20.....	Jungle Operations.

FM 100-series	(Field Service Regulations.)
FM 101-series	(Staff Officers.)
FM 105-5	Maneuver Control.
FM 110-5	Joint Action; Armed Forces.
(C) FM 110-10	Joint Logistics Policy and Guidance Manual (U).
TM 1-1-series	(Army Aircraft Handbooks.)
TM 3-series	(Chemical.)
TM 5-series	(Engineer.)
TM 5-251	Army Airfields and Heliports.
TM 9-1900	Ammunition, General.
TM 9-1950	Rockets.
TM 9-1981	Military Pyrotechnics.
TM 10-500-series	Aerial Delivery of Supplies and Equipment— General.
TM 10-1101	Petroleum-Handling Operations.
TM 11-series	(Signal.)
TM 11-2557	Jeppesen Airway Manual. (Vols. 1, 2, 3.)
(S) TM 23-200	Capabilities of Atomic Weapons (U).
TM 30-246	Tactical Interpretation of Air Photos.
TM 57-210	Air-Movement of Troops and Equipment.
TM 57-220	Technical Training of Parachutists.
AF TO 00-1-1	Numerical Index of Technical Publications.
AF TO 00-5-1	Explanation of Technical Order and Stock List System.
AF TO 01-1-7	Storage of Aircraft.
AF TO 01-1-50	Ground Handling of Aircraft.
AF TO 01...*-01	List of Applicable Publications.
AF TO 01...*-1	Flight Operations Instructions.
AF TO 01...*-2	Erection and Maintenance Instructions.
AF TO 01...*-3	Structural Repair Instructions.
AF TO 01...*-4	Parts Catalog.
(C) ACP 129	**Communications Instructions, Visual Sig- naling Procedures (U).
ACP 136	**Communications Instructions, Panel Sig- naling.
(C) ACP 150A	**Recognition and Identification Instruc- tions—General (U).
(C) ACP 151A	**Recognition and Identification Instruc- tions—Air Forces and Ground Forces (U).
(C) ACP 165	**Operational Brevity Codes (U).
ACP 168A	**Communications Instructions, Pyrotechnic Signals.

*The identifying aircraft type appears in the center space.

**These Allied Communications Publications are indexed in (C) JANAP 201, Status of Noncryptographic JANAP's and ACP's.

APPENDIX II

AIRCRAFT IDENTIFICATION

<i>Name</i>	<i>Type and Model Designation</i>
SIOUX.....	H-13
CHICKASAW.....	H-19
SHAWNEE.....	H-21
RAVEN.....	H-23
CHOCTAW.....	H-34
MOJAVE.....	H-37
IROQUOIS.....	HU-1
SENECA.....	YH-41
BIRD DOG.....	L-19
BEAVER.....	L-20
SEMINOLE.....	L-23
OTTER.....	U-1A
CARIBOU.....	DEHAVILLAND AC-1
MOHAWK.....	GRUMMAN AO-1
	(OF-1)

APPENDIX III

AVIATION ANNEX TO DIVISION SOP

Example: Annex E (Army Aviation) to 7th Infantry Division SOP.

CLASSIFICATION

Copy No. ----
7th Inf Div
APO 10 U.S. Army
8 Jun 57

1. Purpose

This annex prescribes normal procedures for the employment of Army Aviation organic to the division.

2. Organization for Combat

a. Tactical grouping.

(1) DS Plat.

- (a) Plat Hq—Combt Avn Co.
- (b) Cmbt Spt Flt A—DS ----- Inf Bat GP
- (c) Cmbt Spt Flt B—DS ----- Inf Bat GP
- (d) Cmbt Spt Flt C—DS ----- Inf Bat GP
- (e) Cmbt Spt Flt D—DS ----- Inf Bat GP
- (f) Cmbt Spt Flt E—DS ----- Inf Bat GP
- (g) Arty Flt—DS Div Arty.
- (h) Target Acquisition Sec—DS ---- Armd Cav Sq.
- (i) General. All avn spt elms may be atch to supported units when required by tactical sit. When atch, admin spt rendered by tactical unit will not include avn med svc, pers parachute maint or maint of avn electronics. These responsibilities remain with the cmbt avn co or appropriate tech svc.

(2) GS Plat. Op con div avn sec to provide:

- (a) Spt for div comdr and div hq.
- (b) Spt for div engr and sig elm.
- (c) Reinf DS Platoon.

b. Div Avn Sec. Div main CP.

c. Avn Co (-). Div tn area.

CLASSIFICATION

(Anx E (Army Avn) to SOP)

d. Atch Avn Spt. Avn atch to or placed in spt of the 7th Inf Div from other units will be placed under op con of the div avn officer or empl as required in spt of div msn.

3. Intelligence

a. Reconnaissance and Surveillance.

- (1) Preplanned vis and photo air recon msn within capabilities of DS or atchd fts or secs asgd by units being supported.
- (2) Avn capabilities of organic army avn will be fully exploited prior to req for inter service spt.
- (3) Req for pers airlift in spt of extended gnd recon submitted thru comd channels.
- (4) Obsn.
 - (a) Area coverage of all organic avn elm coordinated by div avn sec.

(b) Extent of area coverage rept to div avn sec.

b. En material. Avn Maint O provide tech assistance to Div G2 for capt en avn material.

c. Req for avn charts and photos directed to div engr.

d. Counterintelligence.

- (1) Pers forced down behind en lines and not retrieved immed will move to pickup points designated in avn annex to div op order. Pickup points will not be occupied except for periods of 30 min prior to and fol sunrise and sunset unless mutual ident between down pers and pickup acft has been est.
- (2) Documents containing classified information, except daily SOI, will not be carried fwd of friendly battle posits.

4. Operations

a. Security.

- (1) Local security of base airstrip responsibility of avn co comdr. Area def responsibility of tn comdr.
- (2) Local security of forward airstrip responsibility of senior avn officer. Area def responsibility of supported unit.
- (3) The operations officer will designate safety areas for aircraft during employment of proximity fuze or nuclear weapons. The plan for evacuation of danger areas will be as incorporated in corps and army SOP's.

b. Combat.

- (1) DS or atch avn elm cease on div order.

CLASSIFICATION

CLASSIFICATION

(Anx E (Army Avn) to SOP)

- (2) Lateral comm maintained between DS or atchd elm on fwd airstrips.
- (3) Req for offensive air as cover for org avn elm submitted thru comd or air request channels to fire spt coordinator.
- (4) Req for lifting of friendly gnd fires to permit org avn empl submitted to G3 and FSC.
- (5) Rept loc all airstrips prior to occupation.
- (6) Req for engr avn spt coord with div avn O.
- (7) CBR.

(a) Defensive—See Annex A, Div SOP.

(b) Offensive—Org or atchd avn empl in CBR distr on order div comdr.

- (8) Smoke. Org or atchd avn empl as smoke distr on div order and coord with G3.
- (9) Battle area illumination. Org or atchd avn empl as illumination means on div order and coord with G3.
- (10) Air def. Acft atk by en air or gnd fire take evasive action and immediate rept of loc, type, and quantity of en action to div def agencies.
- (11) Def against nuclear atk. All avn elm constantly alert for en action indicating empl of nuclear weapons. Following empl of nuclear weapons by en, obsn and survey effort concentrated on detection of en attempts to exploit effects.

(a) DS Elm—be prepared to:

1. Provide emergency peak load aeromedical evac as primary msn.
2. Provide instrument survey and monitoring of blast and fallout areas.

(b) GS Plat.

1. Prov airlift for immediate survey of blast area on div order.
2. Prov airlift for instrument survey and monitoring of blast and fallout areas on div order.

c. *Movement.*

- (1) DS elm displ with supported unit. Prior notification of new airstrip to div avn sec.
- (2) Div avn sec displ with main CP.
- (3) Avn Co. (—) displace with div tn or trp as appropriate.

CLASSIFICATION

(Anx E (Army Avn) to SOP)

5. Logistics

a. Supply.

(1) Cl I.

- (a) DS elm by supported units.
- (b) Div avn sec by div hq co.
- (c) Remainder as prescribed.
- (d) Two individual combat rations per place in each acft.

(2) Cl II and IV.

- (a) DS or atchd avn elm rec avn items directly from avn co.
All other items thru supported unit.
- (b) Remainder of co by req to approp tech svc.

(3) Cl III (IIIA).

- (a) All elm maintain prescribed load.
- (b) Resupply of avn POL by direct req to div QM.
- (c) DS elm by supported unit.

(4) Salvage. Avn items salv by cmbt avn co.

b. Logistics employment.

- (1) Aerial supply. By req to div G4 and div trans officer.
- (2) Aeromed evac. By req to div surg.
- (3) Aerial pers trans. By req to div G4.

6. Reports

Daily status report for all acft to be submitted with cmbt veh status rept by:

- a.* Supported units for DS or atchd acft.
- b.* Avn co for all other acft.

BLACK
Maj Gen

DISTR: A.

OFFICIAL:

/s/ Blue

BLUE

G3

CLASSIFICATION

APPENDIX IV

AVIATION ANNEX TO OPERATIONS ORDER

CLASSIFICATION

Copy Nr 2
20th Inf Div
ASWAN, EGYPT
211900 Jan 19 ----
PX 52

Annex E (Army Aviation) to OpO 11

Reference: Map, EGYPT, 1:100,000, ASWAN—QUINA.

1. Situation

a. Enemy. OpO 11.

b. Friendly. OpO 11.

c. Attachments and Detachments. 415th Trans Transport Acft Bn (3 co H-34) atchd effective 120330 Aug; detached 130001 Aug.

2. Mission

OpO 11.

3. Execution

a. Concept of Op. OpO 11.

b. 20th Avn Co:

(1) DS platoon:

(a) Arty flight:

1. Spt div arty with—8 L-19s, 1 H-13 operational aircraft.
2. Provide continuous target area surveillance, aerial adjustment of fires and registration for each mortar battery and for div arty units.

(b) Target acquisition flight:

1. GS div priority spt to the 1st Recon Sq, 21st Cav.
2. Maintain area surveillance as set forth in aerial surveillance plan.

(c) Combat spt flight:

1. Combat spt flights A, B, and C spt $\frac{1}{61}$, $\frac{2}{62}$, and $\frac{3}{63}$ Inf with two operational H-13 helicopters each.
2. Combat spt flights D and E attached to 20th Inf Div Brig; one additional H-13 helicopter attached to each flight.

CLASSIFICATION

(Annex E to OpO 11—20th Inf Div)

(2) General spt platoon:

(a) Attach to 20th Inf Div Brig provisional combat spt flight; 2-L-19, 2-H-13, 1-L-20, necessary personnel to include one aviator to function as 20th Inf Div Brig AvnO.

(b) Platoon (-): GS.

(c) 415th Transport Avn Bn (3 co H-34):

1. Establish and operate MCC vicinity div FSCC.
2. Provide lift for $\frac{1}{61}$ Inf to obj 1.
3. Attach six operational H-34 to $\frac{1}{61}$ Inf upon completion of tactical lift to obj 1.
4. Maintain 8 operational H-34's for on call movement of supplies or equipment.
5. Bn (-) remain in ready areas in div rear upon delivery of $\frac{1}{61}$ to obj 1. Prepare to move $\frac{3}{63}$ Inf (div res) to obj 1, 2, or 3 on order.

d. Coordinating instructions:

1. Aircraft identification procedures no change from SOP.
2. All aircraft operating in div area above 300' will monitor either MCC or base airfield control frequencies.
3. Any aircraft desiring to operate at altitudes over 1,500 ft must obtain prior clearance from MCC.
4. Aircraft desiring to operate from H-25 to H-5 min must obtain clearance from MCC.

4. Administration and Logistics

AdminO 5.

5. Command and Signal

a. SOI 2—9.

b. All army avn assigned or attached to div under operational control of div avnO unless otherwise specified.

c. Div MCC vicinity 6945.

d. Appendix 1, Army Aviation Command and Control Plan. Acknowledge.

NEW
Maj Gen

Appendix: 1—Army Aviation Command and Control Plan.

Distribution: B.

OFFICIAL:

/s/ Planner

PLANNER

G3

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APPENDIX V

AERIAL PHOTOGRAPHY

1. Photography Formulas

The following formulas are necessary for computing problems connected with photography mission planning:

a. Altitude (Vertical). To determine the relationship between altitude, camera focal length, and scale in vertical photography:

- (1) Use the formula $RF = \frac{F}{12H}$ where:

RF = Representative fraction

F = Focal length of camera in inches

H = Altitude of the camera above the ground in feet.

- (2) For example: If $F=6$ inches and $H=5,000$ feet, then

STEP 1. $RF = \frac{6}{12 \times 5,000}$

STEP 2. $RF = 1:10,000$

b. Interval. To determine the time interval between exposures with a standard 60% overlap:

- (1) Use the formula $I = \frac{GC(1-OL)}{GS}$ where:

I = Interval in seconds

GC = Longitudinal ground coverage

OL = Percent overlap desired expressed decimally.

GS = Groundspeed in ft/sec

- (2) For example, if a 25% overlap is desired, a 6-inch focal length at 5,000 feet altitude is used, and the groundspeed is 80 mph:

$GC = 3,750$ (table V)

$OL = 25\%$ or 0.25

$GS = 80$ mph or 118 ft/sec

STEP 1. $I = \frac{3,750(1-0.25)}{118}$

STEP 2. $I = \frac{3,750(0.75)}{118}$

STEP 3. $I = \frac{2,812.5}{118}$

STEP 4. $I = 23.9$ seconds

c. *Film Requirements.* To determine film requirements for a given oblique or vertical strip with standard overlap:

- (1) Use the formula $P = \frac{D(1+2 \times OL)}{GC} + 1$, where:

P=Number of film frames

D=Ground distance of strip in feet

OL=Percentage of forward overlap expressed decimally

GC=Longitudinal ground coverage

- (2) For example, to photograph a strip $3\frac{1}{2}$ miles in length at an altitude of 5,000 feet, with a desired overlap of 25% and using a camera which has a 6-inch focal length:

D=18,480 feet

OL=0.25

GC=3,750 feet (table V)

$$P = \frac{D(1+2 \times OL)}{GC} + 1$$

$$\text{STEP 1. } P = \frac{18,480(1+2 \times 0.25)}{3,750} + 1$$

$$\text{STEP 2. } P = \frac{18,480(1.5)}{3,750} + 1$$

$$\text{STEP 3. } P = 7.3 + 1$$

$$\text{STEP 4. } P = 8.3 \text{ frames required for coverage}$$

d. *Image Motion.* A motion caused by vibration and forward movement of the aircraft during exposure time is called image motion. The fastest shutter speeds possible should be used under the given light condition. To stop motion, the height and speed of the plane, focal length of the camera, and allowable movement or circle of confusion on film must be considered in the determination of the correct shutter speed.

- (1) The formula to determine correct shutter speed to stop motion is: $S = \frac{A}{366.6 \times G \times F}$ (For 1/250-inch circle of confusion), where

S=Shutter speed (sec)

A=Altitude (feet)

G=Plane speed (mph)

F=Focal length of lens (inches)

- (2) For example, your altitude is 2,000 feet and your ground-speed is 80 mph. Your camera has a 6-inch focal length.

$$\text{STEP 1. } S = \frac{2,000 \text{ feet}}{366.6 \times 80 \times 6}$$

$$\text{STEP 2. } S = 0.011 \text{ or } 11/1000$$

$$\text{STEP 3. } S = 1/90 \text{ of a second}$$

Note. The speed (S) computed above represents the slowest shutter speed which can be used under the given conditions. If the computed shutter speed is not available on the camera, use the next faster shutter speed.

2. Filter Data

Filters are more important in aerial photography than in terrestrial or ground photography. Even when the atmosphere seems perfectly clear from the ground, aerial observation will show a slight haze which increases in density with altitude. The K-20 camera set is equipped with two gelatin filters: the minus-blue No. 12 yellow filter, which totally excludes the blue band and is useful for haze under strong lighting conditions; and the light red No. 25 red filter which excludes green, blue, and violet bands. These two filters are commonly referred to as yellow and red filters. The red filter is used when coverage must be accomplished at high altitudes, or in conjunction with infrared film.

a. The filter factor with Aero Pan film (index 100) is 2 for the yellow filter and 4 for the red filter.

b. Problems of haze vary with the type of shot. At the same general altitude, a vertical shot has the least amount of haze to penetrate; a low oblique, somewhat more haze; and a high oblique, the greatest amount of haze (table I).

Table I. Camera Filters

	Altitude in feet	Relatively no haze	Light haze	Heavy haze
Verticals-----	1, 000	No filter----	No filter-----	Yellow.
	2, 000	No filter----	No filter-----	Yellow.
	2, 000-5, 000	No filter----	Yellow-----	Yellow or red.
Low obliques, 30-60---	1, 000	No filter----	No filter-----	Yellow.
	2, 000	No filter----	No filter or yellow.	Yellow.
	2, 000-5, 000	No filter----	Yellow-----	Yellow or red.
High obl. to 60 and in- cluding the horizon.	1, 000	No filter----	Yellow-----	Red.
	2, 000	Yellow-----	Yellow-----	Red.
	2, 000-5, 000	Yellow-----	Yellow-----	Red.

c. When coverage is from 2,000 feet or less and the day is fairly clear, no filter should be necessary for taking verticals and low obliques. High obliques may require the use of the yellow filter. The photographer must judge by experience.

d. If using a filter, compensate either the shutter speed or f/number as follows:

- (1) Yellow filter: Increase aperture opening one stop, or decrease shutter speed by one-half.
- (2) Red filter: Increase aperture opening two stops, or decrease shutter speed twice.

3. Photography Planning Scales

Hard and fast rules for scales cannot be fixed. Examples of recommended scales for specific uses are given in table III.

Table II. Groundspeed Conversion

Mph	Knots	Ft/sec	Mph	Knots	Ft/sec
60-----	52	88	110-----	96	161
70-----	61	103	120-----	104	176
80-----	70	118	130-----	113	191
90-----	78	132	140-----	122	205
100-----	87	147			

Table III. Photography Planning Scales

Scale	Item
1:1,000-----	To count single and scattered personnel.
1:2,000-----	Underwater obstacles.
1:3,000-----	Radar, by type.
	Electronic equipment, by type.
1:4,000-----	Detection of enemy observation posts.
	Armored and tracked vehicles, by type.
	Antitank weapons positions.
1:5,000-----	Camouflaged artillery positions.
	Damage assessment in frontline areas.
	Grouped personnel.
	Pillboxes.
	Searchlights.
	Command posts.
1:7,000-----	Light antiaircraft positions (A/W and MG).
	Trafficability of terrain.
	Damage assessment in immediate enemy rear areas.
	Roadblocks.
	Serviceability of roads and railroads.
	Temporary and small bridges.
	Fords.
	Small aircraft.
	Type of vegetation.
1:8,000-----	Large communication installations and equipment.
	Artillery in the open, by type.
	Coastal defense positions.
1:10,000-----	Occupied assembly areas.
	Antitank ditches.
	Trenches and foxholes.
	Large bridges.
	Airfields and supporting installations.
	Heavy antiaircraft positions.
	Large aircraft, by type.
	Radar and installations.

Table IV. Scale Charts

Altitude in feet	6-in. lens 2×alt. =scale	6¾-in. lens 1.882×alt. =scale	8-in. lens 1.5×alt. =scale	8¼ in. lens 1.454×alt. =scale	12-in. lens 1.0×alt. =scale	20-in. lens 0.6×alt. =scale	24-in. lens 0.5×alt. =scale
1,000-----	2,000	1,882	1,500	1,454	1,000	600	500
2,000-----	4,000	3,764	3,000	2,908	2,000	1,200	1,000
3,000-----	6,000	5,646	4,500	4,362	3,000	1,800	1,500
4,000-----	8,000	7,528	6,000	5,816	4,000	2,400	2,000
5,000-----	10,000	9,410	7,500	7,270	5,000	3,000	2,500
6,000-----	12,000	11,292	9,000	8,724	6,000	3,600	3,000
7,000-----	14,000	13,174	10,500	10,178	7,000	4,200	3,500
8,000-----	16,000	15,056	12,000	11,632	8,000	4,800	4,000
9,000-----	18,000	16,938	13,500	13,086	9,000	5,400	4,500
10,000-----	20,000	18,820	15,000	14,540	10,000	6,000	5,000
11,000-----	22,000	20,702	16,500	15,994	11,000	6,600	5,500
12,000-----	24,000	22,584	18,000	17,448	12,000	7,200	6,000
13,000-----	26,000	24,466	19,500	18,902	13,000	7,800	6,500
14,000-----	28,000	26,348	21,000	20,356	14,000	8,400	7,000
15,000-----	30,000	28,230	22,500	21,810	15,000	9,000	7,500

Table V. Aerial Camera Coverage and Interval Tables
(Vertical and Oblique)

6-inch lens, $4\frac{1}{2} \times 4\frac{1}{2}$ -inch plate

Altitude above terrain (vertical) or point distance (oblique)	Scale R. F. = 1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), vertical mosaics, 40 percent side overlap, map scale—		Groundspeed (mph)							
							1:25,000	1:50,000	80	90	100	110	120	130	140	150
							Exposure intervals (seconds)									
1,000.....	2,000	750	300	17.60	750	450	0.22	0.11	2.4	2.2	2	1.8	1.7	1.6	1.5	1.4
2,000.....	4,000	1,500	600	8.80	1,500	900	.43	.22	5	4.4	4	3.6	3.4	3	2.8	2.6
3,000.....	6,000	2,250	900	5.87	2,350	1,350	.65	.32	7.6	6.8	6	5.4	5	4.6	4.2	4
4,000.....	8,000	3,000	1,200	4.40	3,000	1,800	.86	.43	10	9	8	7.4	6.8	6.2	5.8	5.4
5,000.....	10,000	3,750	1,500	3.52	3,750	2,250	1.08	.54	13	11	10	9.2	8.4	7.8	7.2	6.8
6,000.....	12,000	4,500	1,800	2.93	4,500	2,700	1.30	.65	15	14	12	11	10	9.4	8.6	8
7,000.....	14,000	5,250	2,100	2.51	5,250	3,150	1.51	.76	18	16	14	13	12	11	10	9.4
8,000.....	16,000	6,000	2,400	2.20	6,000	3,600	1.73	.86	20	18	16	15	14	12	11	10
9,000.....	18,000	6,750	2,700	1.95	6,750	4,050	1.94	.97	22	20	18	17	15	14	13	12
10,000.....	20,000	7,500	3,000	1.76	7,500	4,500	2.16	1.08	24	22	20	18	17	16	15	14
11,000.....	22,000	8,250	3,300	1.60	8,250	4,950	2.38	1.19	28	24	22	20	19	17	16	15
12,000.....	24,000	9,000	3,600	1.47	9,000	5,400	2.59	1.29	30	26	24	22	20	19	17	16
13,000.....	26,000	9,750	3,900	1.35	9,750	5,850	2.81	1.40	32	28	26	24	22	20	19	18
14,000.....	28,000	10,500	4,200	1.26	10,500	6,300	3.02	1.51	34	30	28	26	23	22	20	19
15,000.....	30,000	11,250	4,500	1.17	11,250	6,750	3.24	1.62	38	34	30	28	24	23	21	20

Table VI. *Aerial Camera Coverage and Interval Tables*
(Vertical and Oblique)

6½-inch lens, 4×5-inch plate
(5-inch side longitudinal)

Altitude above terrain (vertical) or camera-mid- point distance (oblique)	Scale R. F. = 1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), vertical mosaics, 40 percent side overlap, map scale—		Groundspeed (mph)								Exposure intervals (seconds)											
							1:25,000	1:50,000	80	90	100	110	120	130	140	150	2.7	2.4	2.1	1.9	1.8	1.6	1.5	1.4				
1,000.....	1,880	784	314	16.82	627	376	0.18	0.09	2.7	2.4	2.1	1.9	2.1	1.9	1.8	1.6	1.5	1.4										
2,000.....	3,760	1,568	627	8.43	1,254	752	.36	.18	5.3	4.8	4.3	3.9	4.3	3.9	3.6	3.3	3.1	2.8										
3,000.....	5,640	2,352	941	5.61	1,882	1,120	.54	.28	8	7.1	6.4	5.9	5.4	4.9	4.6	4.3	4.0	3.7										
4,000.....	7,520	3,137	1,255	4.21	2,509	1,506	.72	.36	11	9.5	8.5	7.8	7.1	6.6	6.1	5.7	5.4	5.1										
5,000.....	9,410	3,921	1,569	3.36	3,137	1,883	.90	.45	19	12	11	9.8	8.9	8.2	7.6	7.1	6.7	6.4										
6,000.....	11,290	4,705	1,882	2.81	3,764	2,259	1.08	.54	16	14	13	12	11	10	9.4	8.8	8.2	7.7										
7,000.....	13,170	5,490	2,196	2.40	4,392	2,636	1.26	.63	19	17	15	14	13	12	11	10	9.2	8.5										
8,000.....	15,060	6,274	2,510	2.10	5,019	3,012	1.45	.72	21	19	17	16	14	13	12	11	10	9.2										
9,000.....	16,940	7,058	2,823	1.87	5,647	3,389	1.63	.81	24	21	19	18	16	15	14	13	12	11										
10,000.....	18,880	7,843	3,138	1.68	6,274	3,765	1.81	.90	27	24	21	20	18	16	15	14	13	12										
11,000.....	20,700	8,627	3,451	1.53	6,901	4,142	1.98	.99	29	26	23	21	20	18	17	16	15	14										
12,000.....	22,580	9,411	3,764	1.40	7,529	4,519	2.17	1.08	32	29	26	23	21	20	18	17	16	15										
13,000.....	24,470	10,196	4,079	1.29	8,156	4,895	2.35	1.18	35	31	28	25	23	21	20	19	18	17										
14,000.....	26,350	10,980	4,392	1.20	8,784	5,272	2.53	1.26	37	33	30	27	25	23	21	20	19	18										
15,000.....	28,230	11,764	4,706	1.12	9,411	5,648	2.71	1.35	40	36	32	29	27	25	23	21	20	19										

Table VII. Aerial Camera Coverage and Interval Tables
(Vertical and Oblique)

8-inch lens, $4\frac{1}{4} \times 4\frac{1}{2}$ -inch plate

Altitude above terrain (vertical) or camera-mid-point distance (oblique)	Scale R. F. = 1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), 40 percent side overlap, map scale—		Groundspeed (mph)						Exposure intervals (seconds)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
							1:25,000	1:50,000	80	90	100	110	120	130	140	150	1.9	1.7	1.5	1.3	1.2	1.1	1.1	1	1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
1,000.....	1,500	562	225	23.48	562	337	0.16	0.08	3.8	3.4	3	2.7	2.5	2.3	2.1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table VIII. Aerial Camera Coverage and Interval Tables
(Vertical and Oblique)

12-inch lens, $4\frac{1}{2}$ -X $4\frac{1}{2}$ -inch plate.

Altitude above terrain (vertical) or camera-mid- point distance (oblique)	Scale R.F.=1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), 40 percent side overlap, map scale---		Groundspeed (mph)										
							1:25,000	1:50,000	80	90	100	110	120	130	140	150			
							Exposure intervals (seconds)												
1,000.....	1,000	375	150	35.20	375	225	0.11	0.05	1.2	1.1	1	0.92	0.85	0.78	0.73	0.68			
2,000.....	2,000	750	300	17.60	750	450	.22	.11	2.5	2.2	2	1.8	1.7	1.5	1.4	1.3			
3,000.....	3,000	1,125	450	11.74	1,125	675	.32	.16	3.8	3.4	3	2.7	2.5	2.3	2.1	2			
4,000.....	4,000	1,500	600	8.80	1,500	900	.43	.22	5.1	4.5	4	3.7	3.4	3.1	2.9	2.7			
5,000.....	5,000	1,875	750	7.04	1,875	1,125	.54	.27	6.3	5.6	5	4.6	4.2	3.9	3.6	3.4			
6,000.....	6,000	2,250	900	5.87	2,250	1,350	.65	.32	7.6	6.8	6	5.5	5.1	4.7	4.3	4			
7,000.....	7,000	2,625	1,050	5.03	2,625	1,575	.76	.38	8.9	7.9	7	6.5	5.9	5.5	5.1	4.7			
8,000.....	8,000	3,000	1,200	4.40	3,000	1,800	.86	.43	10	9	8	7.4	6.8	6.1	5.8	5.4			
9,000.....	9,000	3,375	1,350	3.91	3,375	2,025	.97	.48	11	10	9	8.3	7.6	7	6.5	6.1			
10,000.....	10,000	3,750	1,500	3.52	3,750	2,250	1.08	.54	12	11	10	9.2	8.5	7.8	7.3	6.8			
11,000.....	11,000	4,125	1,650	3.20	4,125	2,475	1.19	.60	13	12	11	10	9.3	8.6	8	7.5			
12,000.....	12,000	4,500	1,800	2.93	4,500	2,700	1.29	.65	15	13	12	11	10	9.4	8.7	8.1			
13,000.....	13,000	4,875	1,950	2.71	4,875	2,925	1.40	.70	16	14	13	12	11	10	9.4	8.8			
14,000.....	14,000	5,250	2,100	2.51	5,250	3,150	1.51	.76	17	15	14	13	11	11	10	9.5			
15,000.....	15,000	5,625	2,250	2.35	5,625	3,375	1.62	.81	19	17	15	13	12	11	10	10			

Table IX. Aerial Camera Coverage and Interval Tables
(Vertical and Oblique)

12-inch lens, 5-×5-inch plate

Altitude above terrain (vertical) or camera-mid-point distance (oblique)	Scale R, F = 1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), vertical mosaics, 40 percent side overlap, map scale—		Groundspeed (mph)							
							1:25,000	1:50,000	80	90	100	110	120	130	140	150
							Exposure intervals (seconds)									
1,000	1,000	417	167	31.60	417	250	0.12	0.06	1.4	1.2	1.1	1	0.95	0.88	0.81	0.76
2,000	2,000	835	334	15.80	835	500	.24	.12	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.5
3,000	3,000	1,250	500	10.55	1,250	750	.36	.18	4.2	3.8	3.4	3.1	2.8	2.6	2.4	2.2
4,000	4,000	1,667	666	7.93	1,667	1,000	.48	.24	5.6	5	4.5	4.1	3.8	3.5	3.2	3.0
5,000	5,000	2,084	833	6.34	2,084	1,250	.60	.30	7	6.3	5.7	5.2	4.7	4.3	4	3.8
6,000	6,000	2,500	1,000	5.28	2,500	1,500	.72	.36	8.5	7.6	6.8	6.2	5.7	5.2	4.9	4.5
7,000	7,000	2,917	1,166	4.52	2,917	1,750	.84	.42	9.9	8.8	7.9	7.2	6.6	6.1	5.7	5.3
8,000	8,000	3,333	1,332	3.96	3,333	2,000	.96	.48	11	10	9.1	8.3	7.6	7	6.5	6.1
9,000	9,000	3,750	1,500	3.52	3,750	2,250	1.08	.54	13	11	10	9.3	8.5	7.9	7.3	6.8
10,000	10,000	4,167	1,666	3.17	4,167	2,500	1.20	.60	14	13	11	10	9.5	8.7	8.1	7.6
11,000	11,000	4,584	1,833	2.88	4,584	2,750	1.32	.66	15	14	12	11	10	9.6	8.9	8.3
12,000	12,000	5,000	2,000	2.64	5,000	3,000	1.44	.72	17	15	14	12	11	10	9.7	9.1
13,000	13,000	5,417	2,166	2.44	5,417	3,250	1.56	.78	18	16	15	13	12	11	10	9.8
14,000	14,000	5,835	2,333	2.26	5,835	3,500	1.68	.84	20	18	16	14	13	12	11	10
15,000	15,000	6,250	2,500	2.11	6,250	3,750	1.80	.90	21	19	17	15	14	13	12	11

Table X. *Aerial Camera Coverage and Interval Tables*
(Vertical and Oblique)

12-inch lens, 9-×9-inch plate

Altitude above terrain (vertical) or camera-mid- point distance (oblique)	Scale R.F.=1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), vertical mosaics, 40 percent side overlap, map scale—		Groundspeed (mph)									
							1:25,000	1:50,000	Exposure intervals (seconds)									
									2.4	2.2	2	1.8	1.7	1.6	1.5	1.4		
1,000.....	1,000	750	300	17.60	750	450	0.22	0.11	5	4.4	4	3.6	3.4	3	2.8	2.6		
2,000.....	2,000	1,500	600	8.80	1,500	900	.43	.22	7.6	6.8	6	5.4	5	4.6	4.2	4		
3,000.....	3,000	2,250	900	5.87	2,250	1,350	.65	.32	10	9	8	7.4	6.8	6.2	5.8	5.4		
4,000.....	4,000	3,000	1,200	4.40	3,000	1,800	.86	.43	13	11	10	9.2	8.4	7.8	7.2	6.8		
5,000.....	5,000	3,750	1,500	3.52	3,750	2,250	1.08	.54	15	14	12	11	10	9.4	8.6	8		
6,000.....	6,000	4,500	1,800	2.93	4,500	2,700	1.30	.65	16	14	12	11	10	9.4	8.6	8		
7,000.....	7,000	5,250	2,100	2.51	5,250	3,150	1.51	.76	18	16	14	13	12	11	10	9.4		
8,000.....	8,000	6,000	2,400	2.20	6,000	3,600	1.73	.86	20	18	16	15	14	13	12	11		
9,000.....	9,000	6,750	2,700	1.95	6,750	4,050	1.94	.97	22	20	18	17	15	14	13	12		
10,000.....	10,000	7,500	3,000	1.76	7,500	4,500	2.16	1.08	24	22	20	18	17	16	15	14		
11,000.....	11,000	8,250	3,300	1.60	8,250	4,950	2.38	1.19	28	24	22	20	19	17	16	15		
12,000.....	12,000	9,000	3,600	1.47	9,000	5,400	2.59	1.29	30	26	24	22	20	19	17	16		
13,000.....	13,000	9,750	3,900	1.35	9,750	5,850	2.81	1.40	32	28	26	24	22	20	19	18		
14,000.....	14,000	10,500	4,200	1.26	10,500	6,300	3.02	1.51	34	30	28	26	23	22	20	19		
15,000.....	15,000	11,250	4,500	1.17	11,250	6,750	3.24	1.62	38	34	30	26	24	23	21	20		

Table XI. *Aerial Camera Coverage and Interval Tables*
(Vertical and Oblique)

20-inch lens, 5-× 5-inch plate

Altitude above terrain (vertical) or camera-mid-point distance (oblique)	Scale R.F. = 1: (at horizontal centerline for oblique)	Longitudinal ground coverage, feet (at horizontal centerline for obliques)	Ground advance between exposures, 60 percent overlap (ft)	Photos/mile	Lateral ground coverage, in feet	Lateral coverage, verticals, 40 percent side overlap, in feet	Flight line separation (inches), vertical mosaics, 40 percent side overlap, map scale—		Groundspeed (mph)							Exposure intervals (seconds)						
1,000.....	600	250	100	52.80	250	150	.07	.04	0.85	0.76	0.68	0.62	0.57	0.52	0.49	0.45						
2,000.....	1,200	500	200	26.40	500	300	.14	.07	1.7	1.5	1.4	1.2	1.1	1	.97	.91						
3,000.....	1,800	750	300	17.60	750	450	.22	.11	2.5	2.3	2	1.9	1.7	1.6	1.5	1.5						
4,000.....	2,400	1,000	400	13.20	1,000	600	.29	.14	3.4	3	2.7	2.5	2.3	2.1	1.9	1.8						
5,000.....	3,000	1,250	500	10.56	1,250	750	.36	.18	4.2	3.8	3.4	3.1	2.8	2.6	2.4	2.3						
6,000.....	3,600	1,500	600	8.80	1,500	900	.43	.22	5.1	4.5	4.1	3.7	3.4	3.1	2.9	2.7						
7,000.....	4,200	1,750	700	7.54	1,750	1,050	.50	.25	5.9	5.3	4.8	4.4	4	3.7	3.4	3.2						
8,000.....	4,800	2,000	800	6.64	2,000	1,200	.58	.29	6.8	6.1	5.4	5	4.5	4.2	3.9	3.6						
9,000.....	5,400	2,250	900	5.87	2,250	1,350	.65	.32	7.6	6.8	6.1	5.6	5.1	4.7	4.4	4.1						
10,000.....	6,000	2,500	1,000	5.28	2,500	1,500	.72	.36	8.5	7.6	6.8	6.2	5.7	5.2	4.9	4.5						
11,000.....	6,600	2,750	1,100	4.79	2,750	1,650	.79	.40	9.3	8.3	7.5	6.8	6.3	5.8	5.4	5						
12,000.....	7,200	3,000	1,200	4.40	3,000	1,800	.86	.43	10	9.1	8.2	7.5	6.8	6.3	5.8	5.5						
13,000.....	7,800	3,250	1,300	4.04	3,250	1,950	.94	.47	11	9.8	8.8	8.1	7.4	6.8	6.3	5.9						
14,000.....	8,400	3,500	1,400	3.77	3,500	2,100	1.01	.50	12	11	9.5	8.7	8	7.3	6.8	6.4						
15,000.....	9,000	3,750	1,500	3.52	3,750	2,250	1.08	.54	13	12	10	9.3	8.5	7.9	7.3	6.8						

Table XII. *Aerial Camera Coverage and Interval Tables*
(Vertical and Oblique)

24-inch lens, $4\frac{1}{2} \times 4\frac{1}{2}$ -inch plate

Altitude above terrain (vertical) or camera-mid- point distance (oblique)	Scale R. F. = 1: (at horizontal centerline for oblique)	Longitudi- nal ground coverage, feet (at horizontal centerline for oblique)	Ground advance between exposures, 60 percent overlap (ft)	Photos/ mile	Lateral ground coverage, verticals, in feet	Lateral coverage, verticals, 40 percent side over- lap, in feet	Flight line separation (inches), 40 percent side overlap, map scale—		Groundspeed (mph)									
									Exposure intervals (seconds)									
									1:25,000	1:50,000	80	90	100	110	120	130	140	150
1,000.....	500	187	75	70.40	187	113	.05	.03	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3
2,000.....	1,000	375	150	35.20	375	225	.11	.05	1.2	1.1	1	1	1	.9	.8	.7	.7	.6
3,000.....	1,500	567	225	23.48	567	337	.16	.08	1.9	1.7	1.5	1.3	1.3	1.2	1.1	1.1	1	1
4,000.....	2,000	750	300	17.60	750	450	.22	.11	2.5	2.2	2	2	2	1.8	1.7	1.5	1.4	1.3
5,000.....	2,500	937	375	14.08	937	567	.27	.14	3.1	2.8	2.5	2.3	2.3	2.1	1.9	1.8	1.7	1.7
6,000.....	3,000	1,125	450	11.74	1,125	675	.32	.16	3.8	3.4	3	3	3	2.7	2.5	2.3	2.1	2.0
7,000.....	3,500	1,313	525	10.06	1,313	787	.38	.19	4.4	3.9	3.5	3.2	3.2	2.9	2.7	2.5	2.3	2.3
8,000.....	4,000	1,500	600	8.80	1,500	900	.43	.22	5.1	4.5	4	4	4	3.7	3.4	3.1	2.9	2.7
9,000.....	4,500	1,687	675	7.82	1,687	1,013	.48	.24	5.7	5.1	4.6	4.1	4.1	3.8	3.5	3.2	3	3
10,000.....	5,000	1,875	750	7.04	1,875	1,125	.54	.27	6.3	5.6	5.1	4.6	4.6	4.2	3.9	3.6	3.4	3.4
11,000.....	5,500	2,067	825	6.40	2,067	1,237	.60	.30	7	6.2	5.6	5.1	4.6	4.3	4	4.3	4	4
12,000.....	6,000	2,250	900	5.86	2,250	1,350	.65	.32	7.6	6.8	6.1	5.5	5.1	4.7	4.3	4	4	4
13,000.....	6,500	2,437	975	5.42	2,437	1,467	.70	.35	8.3	7.3	6.6	6	5.5	5.1	4.7	4.3	4	4
14,000.....	7,000	2,625	1,050	5.02	2,625	1,575	.76	.38	8.9	7.9	7.1	6.5	6	5.5	5.1	4.7	4.3	4.8
15,000.....	7,500	2,813	1,125	4.70	2,813	1,687	.81	.40	9.5	8.5	7.6	6.9	6.3	5.9	5.4	5.1	4.7	5.1

APPENDIX VI

FILMING PROCEDURES

1. Filming Procedures, Hand-Held Cameras

The hand-held camera offers the simplest form of aerial photography. This type of photography is normally limited to oblique spot and strip coverage, although single picture approximate-verticals can be produced by rolling the aircraft to make an exposure. Drift corrections are unnecessary. To take hand-held camera photographs, proceed as follows:

- a. Position aircraft on the photo course line by use of checkpoint at the correct altitude differential.
- b. Aim camera perpendicular to longitudinal axis of aircraft. Do not touch fuselage.
- c. If a strip is being filmed, maintain approximate straight and level flight at any desired power setting.
- d. Count off the computed interval between exposures.

Note. Avoid tilted pictures by leveling camera with the horizon.

2. Filming Procedures, Oblique Mounted Cameras

a. Determine drift and groundspeed prior to arrival over target area. This may be accomplished by use of ground reference points and/or the E6-B computer.

b. Assume predetermined altitude at the objective area and align aircraft on the photo course by use of checkpoints. Make adjustments to keep the aircraft on desired track during the photo run.

Note. To permit final course adjustment and stabilization, sufficient time must elapse between the time the photo course is begun and the time filming starts.

c. Start intervalometer immediately before reaching the first filming checkpoint equal to the interval to be used on the run.

d. When film run has begun, fly aircraft by reference to directional gyro, flight indicator zero degree-of-bank pointers, and altimeter. Cross-check by use of checkpoints and the oblique sighting device.

e. Utilize every effort to keep aircraft in a zero degree-of-bank attitude.

f. Make minor heading corrections gradually and by rudder only since movement is particularly noticeable in high oblique strips.

g. Do not bank aircraft in order to keep target area centered in the sighting device.

h. Maintain constant altitude.

3. Filming Procedures, Vertical Mounted Cameras (Daylight)

Fly aircraft over friendly territory at the altitude and heading that will be used during the actual photo course to determine groundspeed and drift, and proceed as follows:

a. Set vertical viewfinder and proceed to objective area.

b. Determine drift correction on the course to be flown.

c. Rotate camera the number of degrees equal to the drift, and in direction necessary to align the negative with ground track.

Note. The directional gyro should be set prior to entering the photo course and not reset until all mission filming is accomplished.

d. Upon entering the objective area, assume the predetermined altitude, align the aircraft roughly on course by use of checkpoints, and trim for "hands off" flying at cruise power.

e. Level the camera and viewfinder, and give final course corrections to pilot through use of the viewfinder.

f. To allow for final course adjustments and stabilization time, begin photo course a sufficient time before filming starts.

g. Start intervalometer prior to reaching the first filming checkpoint by the number of seconds equal to the interval to be used on the run.

h. When filming run has begun, fly aircraft by reference to the directional gyro and flight indicator zero degree-of-bank pointers. Degree-of-bank pointers should be matched at all times during filming run.

i. Make minor heading corrections by rudder only.

j. Ignore minor deviations in altitude during filming course.

k. Attempt to maintain constant heading, constant pitch, and zero roll attitude during filming.

Note. In flying multiple strips, courses flown in the opposite direction of the basic course will require a different drift correction and photo interval than that required on the basic course.

4. Filming Procedures, Vertical Mounted Cameras (Night)

The principal difference between night and day photographic reconnaissance is that night photography depends on artificial illumination, with the positioning of the aircraft accomplished either visually, through use of checkpoints, or by use of tracking radar.

Note. Altitudes used for night photography are more limited than those used for daylight photography. Maximum altitude is dependent on the intensity of the photoflash illuminant being used, while minimum altitude is limited by image motion effects.

APPENDIX VII

RADIOLOGICAL SURVEY PLAN

CLASSIFICATION

-----Inf Div Avn Co
Ft Rucker, Ala.
8 Jun 58

Annex ----- to ----- Inf Div Avn Co SOP (Radiological Survey Plan).

1. General

This annex prescribes normal procedures for conducting aerial surveys of fallout following nuclear explosions.

2. Prior Planning

a. The platoon leader of the GS platoon is appointed unit CBR officer. His responsibilities include:

- (1) Training of avn co personnel in radiological survey techniques.
- (2) Coordination of actual surveys.
- (3) Preparation and dissemination of avn co survey plans and compliance with div CBR directives.

b. The communication officer is responsible for maintenance and periodic calibration of avn co RADIAC survey instruments.

c. All pilots and observers should complete the unit CBR school and be proficient in the operation of RADIAC survey instruments, related flight techniques, and safety precautions to be followed during surveys.

d. The avn medical officer will advise on maximum permissible dose rates, record individual exposures, and recommend rotation of survey personnel when exposures require such action.

3. Execution

a. Aerial radiological surveys are performed by the GS platoon under the supervision of the unit CBR officer.

CLASSIFICATION

CLASSIFICATION

(Anx to ---- Inf Div Avn Co SOP (Radiological Survey Plan))

b. Aircrews dispatched on these surveys report by radio radiological intensities from previously designated points shown on overlays attached to aerial maps.

c. Pilots approach fallout areas from upwind side at ---- feet absolute altitude and maintain this altitude throughout the survey. Surveys may be conducted at higher altitudes if radiological intensities exceed ----.

d. Aircraft returning from radiological surveys are parked downwind of personnel until determined safe for normal handling.

Commanding

APPENDIX VIII

AERIAL SURVEY PROCEDURES

1. General

a. Aerial survey procedures are employed in nuclear warfare to rapidly determine the degree of radioactive contamination in the combat zone. The methods recommended herein utilize existing equipment and aircraft, and can be used to obtain reasonably accurate radiological survey data.

b. Personnel requirements include a pilot and a monitor. In aircraft which normally have a copilot, the survey duties suggested below for the pilot should be handled by the copilot.

c. Two procedures are considered: the preselected point and the preselected course methods. Both require presurvey planning utilizing a map or aerial photograph of the area to be surveyed.

d. The following equipment is required:

- (1) Survey meter.
- (2) Intervalometer or stopwatch.
- (3) Data Sheet for Radiological Survey (fig. 30).
- (4) Map or aerial photograph of area to be surveyed.
- (5) Equipment for communication with the Radiological Center (RADC).

2. Preselected Point Method

During presurvey planning, map points within the ground area to be surveyed are selected and numbered, both on the map to be used in the aircraft and that at the control center. These points must be readily identifiable from the air (well-defined manmade structures, road junctions, and other prominent landmarks) and must be sufficient in number, as well as appropriately dispersed throughout the area, so that the aerial readings will provide a basis for plotting the ground level dose rate contours. Readings must be taken at the same altitude over all selected ground points. For accuracy, this altitude should be under 200 feet. The pilot notifies the monitor (by intercom) when the aircraft is directly over a specific check-point and the monitor then notes and records the dose rate reading over that point.

DATA SHEET FOR RADIOLOGICAL SURVEYS (AERIAL)					DATE 27 AUG 58		PAGE / OF / PAGES PARTY #3, RADC, 30th	
MAP KURLSO, 1/50,000, SHEET V		TIME INTERVAL 30 SECONDS		AIRCRAFT TYPE H-13		INSTRUMENT NO. AC 8		
COURSE LEG DESIGNATION		A → B		C → D		E → F		G → H
ALTITUDE, FEET		200		200		200		200
TIME AT START OF LEG		0618		0628		0635		0650
REMARKS PROBE APPARENTLY CONTAMINATED ON LAST TWO LEGS - DATA NOT TRANSMITTED.		DOSE RATE r/hr mr/hr		DOSE RATE r/hr mr/hr		DOSE RATE r/hr mr/hr		DOSE RATE r/hr mr/hr
		1 150		1 250		1 3		1 4
		2 180		2 280		2 3		2 8
		3 200		3 330		3 5		3 15
		4 220		4 390		4 7		4 25
		5 250		5 430		5 10		5 30
		6 210		6 480		6 12		6 35
		7		7 530		7 12		7 35
		8		8 600		8 10		8 20
		9		9		9 12		9
		10		10		10 12		10
		11		11		11 15		11
AIR-GROUND CORRELATION FACTOR DATA		12		12		12 20		12
LOCATION		ALTI- TUDE FEET		DOSE RATE r/hr or mr/hr		13		13
		AIR		GROUND		14		14
A		200		150 330		15		15
C		200		250 450		16		16
F		200		15%hr 30%hr		17		17
						18		18
						19		19
						20		20
MONITOR								
TYPED OR PRINTED NAME AND GRADE JOHN R. JONES, LT				SERVICE NUMBER 0000 000		SIGNATURE John R. Jones		

DA Form 1971-R

Figure 30. Data Sheet for Radiological Survey (DA Form 1971-R).

3. Preselected Course Method

a. The preselected course method of survey will provide more detailed data for plotting purposes than the preselected point method. It requires the use of an auxiliary device (intervalometer or a stopwatch) so that readings can be secured at uniform time intervals along each flight course. During presurvey planning, a number of readily identifiable ground checkpoints, preferably located near the periphery of the area, are chosen and numbered on the

map or aerial photograph. Course lines are then drawn between these points, making a zigzag pattern covering the area (fig. 31). Features such as small streams, railroads, and highways may be utilized as course lines if they are conveniently located.

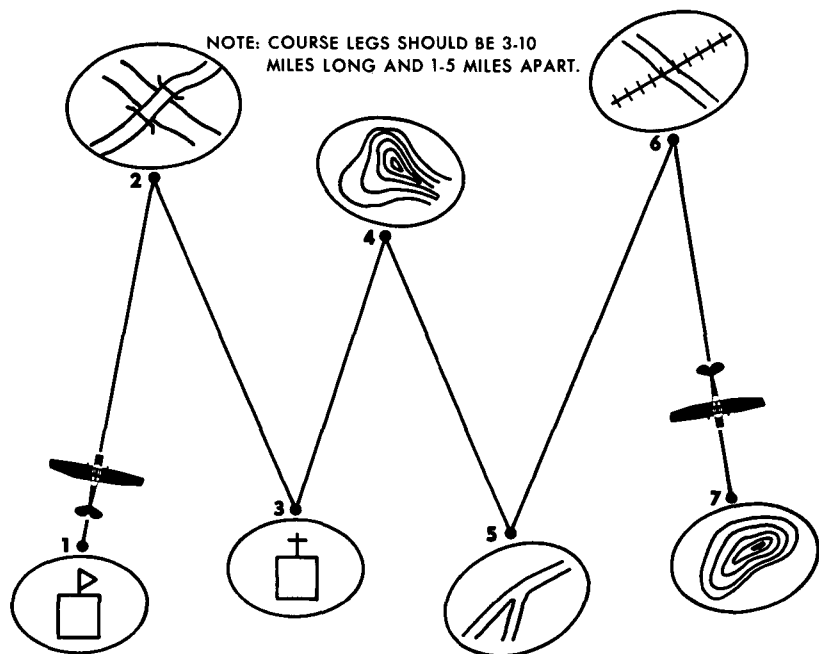


Figure 31. Preselected course survey.

b. The aviator locates the starting checkpoint of the path or course leg to be flown, and either locates the end checkpoint or determines the azimuth of the course leg.

c. The aviator flies the aircraft on the proper course so as to pass over the checkpoint on a straight path to the end checkpoint. When on course, he alerts the monitor. Shortly before reaching the starting point, the monitor records the time.

d. When the aircraft is directly over the starting checkpoint, the aviator commands, "Mark," at which time the monitor reads the survey meter, records the dose rate, and begins timing prearranged intervals.

e. At each prearranged interval of time (e.g., every 10 seconds), the monitor reads the survey meter and records the dose rate.

f. When the aircraft approaches the end checkpoint, the aviator warns the monitor. When directly over the end checkpoint the aviator commands, "Mark," at which time the monitor records the dose rate.

g. Between starting and ending checkpoints, the aviator maintains the lowest possible constant altitude above the ground, as near a constant groundspeed as possible, and as nearly a straight-line course as possible.

h. The monitor may use a stopwatch for making readings at equal intervals, but an intervalometer (emits an audible signal at preset time intervals) is more useful.

4. Correlation Factors

A correlation factor is required for calculating dose rates at the 3-foot level from intensity readings taken from aircraft during the aerial survey. The correlation factor over a given ground point is the ratio of the 3-foot level reading to the reading over that point at the survey altitude. The dose rate at the 3-foot level can be determined either by landing the aircraft near the selected point or hovering with the instrument probe 3 feet off the ground (the preferred method), or by using the factors shown in table XIII.

a. In taking readings from a hovering aircraft, the probe should be mounted on a cable which permits the aircraft to hover at an altitude where the rotor blades will not cause the fallout to be blown away.

b. When aircraft can land or hover to obtain ground readings in the area being surveyed, dose rate readings are taken at a minimum of three points on the ground, and an aerial reading is taken over each point. The three dose rate readings should be uniformly located throughout the surveyed area and reported with the initial survey reading.

c. The average of the ratios for various points within an area is used as the average correlation factor. This factor is multiplied by each of the dose rate readings taken at the survey flight altitude to give dose rates at the 3-foot level throughout the surveyed area.

*Table XIII. Approximate Air-to-Ground Correlation Factors for Use When a Direct Determination Cannot Be Made**

Altitude (feet above ground)	Aircraft	
	Sioux or Bird Dog	Choctaw
50-----	1. 3	1. 8
100-----	1. 6	2. 2
200-----	2. 0	2. 9
300-----	2. 5	4. 0
500-----	3. 5	6. 4
1,000-----	9. 0	17. 0

*Applicable only to an externally mounted probe.

d. When aircraft cannot land or hover in the area being surveyed, the rough correlation factors shown in table XIII can be used.

5. Reporting and Recording

Dose rate readings taken during aerial surveys are recorded by the monitor on DA Form 1971-R (Aerial) (fig. 30) and delivered to the Radiological Center (RADC) after the aerial survey has been completed. Readings may be transmitted to the control party for the survey or to RADC by radio as the survey is being conducted. Final data may be calculated at RADC more quickly when the latter procedure is used.

6. Flight Altitude

The lower the survey flight altitude above the ground, the more reliable the data obtained during the aerial survey. The survey flight altitude should be 200 feet above the ground or less. At altitudes higher than 500 feet above the ground, survey data are highly unreliable. Local terrain and weather conditions influence selection of the survey flight altitude.

7. Airborne Radioactive Contamination

Most contaminated particles in a radioactive cloud rise to considerable heights; thus, the fallout may extend over an appreciable time and a considerable area. An aerial survey conducted during the first hour or two after fallout begins in an area, may be in error because of contaminants still suspended in the air. These airborne contaminants may also be a hazard to monitoring personnel. Therefore, aerial survey is initiated as early as safety permits and repeated over any particular area until fallout is essentially complete in the area.

APPENDIX IX
SAMPLE REQUEST FORM FOR AIRCRAFT FLARE
EMPLOYMENT

1. Coordinates to be illuminated_____
2. Time and duration of illumination_____
3. Type of illumination desired: ____Area.
____Pinpoint.
4. Requesting unit_____
5. Method of control_____
6. GR approval: ____Yes.
____No.
7. Mission number_____
8. Remarks:

Received by—

Signature

APPENDIX X

Table XIV. Characteristics of Aircraft Flares

Item	Weight (lbs)	Candlepower	Burning time (min-utes)	Rate of descent (ft/sec)	Diameter of area illuminated (yards)	Illumination distance for aimed fire without observation in- struments (yards)	Illumination distance for aimed fire with observa- tion in- struments (yards)	Optimum height for activation of flare (feet)	Fuze time	Projector
Flare, acft pght, Mk 4 & Mod's (Navy).	18	300, 000	3	8	800	1, 400	3, 200	1, 600	Preset 30 to 50 ft below air- craft.	Bomb racks.
Flare, acft pght, Mk 5 & Mod's (Navy).	18	600, 000	3	8	1, 600	1, 800	6, 000	1, 600	300 to 12,000 ft freefall.	Bomb racks on hand.
Flare, acft pght, Mk 6 & Mod's (Navy).	30	1, 000, 000	3½	7. 5	2, 500	2, 500	10, 000	1, 900	300 to 12,000 ft freefall.	Bomb racks on hand.
Flare, acft pght, Mk 8 & Mod's (Navy).	18	500, 000	3	8	1, 250	1, 800	6, 000	1, 600	90 or 120 sec delay.	Bomb racks.
Flare, acft pght, Mk 10 & Mod's (Navy).	30	750, 000	4½	8	1, 800	2, 500	8, 000	2, 250	300 to 12,000 ft freefall.	Bomb racks on hand.
Flare, acft pght, Mk 11 (Navy).	30	1, 000, 000	3	10	2, 500	2, 500	10, 000	1, 900	90, 120, 150, and 180 sec.	Bomb racks.
Flare, acft pght, Mk 24 (Navy).	23	2, 500, 000	2	10	3, 500-4, 000	-----	-----	2, 500	3, 5, 10, 15, 20, 25, and 30 sec.	Bomb racks.
Flare, acft pght, Mk 138 (USAF).	79	1, 500, 000	6	10	1, 500-2, 000	-----	-----	4, 500	1-95 sec (in in- crements of 1 sec).	Bomb racks.
Flare, acft pght, Mk 139 (USAF).	79	3, 000, 000	3	10	3, 000-3, 500	-----	-----	3, 000	1-95 sec (in in- crements of 1 sec).	Bomb racks.


APPENDIX XI


AIR-GROUND PANEL CODES

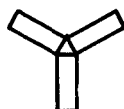
1. Panel System

a. General. The panel system provides ground personnel a limited means of communication with aircraft by means of panels laid out on the ground, or by markings on the soil. The system requires that a message be read from top to bottom. Messages read and understood by the Army aviator are acknowledged by his rocking the wings of the aircraft, or by some other prearranged signal understood by all concerned. Detailed instructions on air-ground panel codes are given in FM 21-60.

b. Flash Index. When using the panel system for relaying air-ground messages, the flash index indicator (fig. 32) should always be displayed before the message is read. Letter and numeral indicators are also shown in figure 32.

 FLASH INDEX - WHEN USED WITHOUT ANOTHER INDICATOR MEANS "READ AS CODE" IN ALL OTHER INSTANCES MEANS: "TOP OF PANEL NUMERALS" AND "DISPLAY READY TO READ"

 LETTER INDICATOR - WHEN DISPLAYED ABOVE THE FLASH INDEX MEANS: "READ AS LETTER"



NUMERAL INDICATOR - WHEN DISPLAYED ABOVE THE FLASH INDEX MEANS: "READ AS NUMBER"

*WHENEVER A DISPLAY IS LAID OUT THAT HAS NEITHER A LETTER NOR A NUMERAL INDICATOR ABOVE IT, THE DISPLAY SHOULD BE READ AS CODE. IF THE DISPLAY READ AS "25", THEN YOU SHOULD REFER TO THE TWENTY-FIFTH ENTRY IN WHATEVER PREARRANGED CODE IS BEING USED BY THE COMMAND.

Figure 32. Panel indicators.

NUMERALS

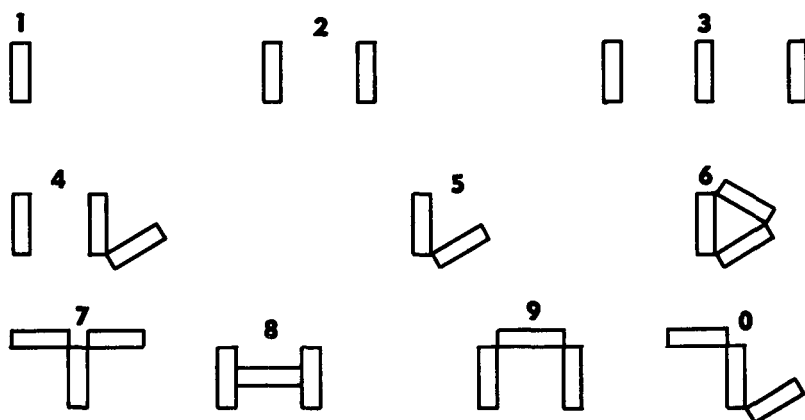


Figure 33. Panel numerals.

c. *Numeral.* Panel numerals used in the panel system are shown in figure 33.

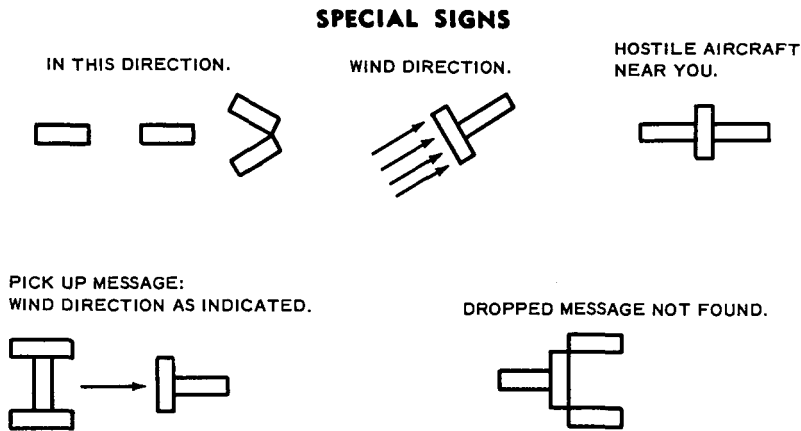




Figure 34. Special signs used in the panel system.

<u>MEANING</u>	<u>DISPLAY</u>	<u>EXPLANATION</u>
THE LETTER "D"		LETTERS INDICATOR FLASH INDEX "READY TO READ"
(D IS THE FOURTH LETTER OF THE ALPHABET)		PANEL NUMERAL 4



<u>MEANING</u>	<u>DISPLAY</u>	<u>EXPLANATION</u>
THE LETTER "P"		"READ AS LETTER" INDICATOR FLASH INDEX
(P IS THE SIXTEENTH LETTER OF THE ALPHABET)		PANEL NUMERAL 1 PANEL NUMERAL 6

Figure 35. Example of panel messages.

d. Special Signs. Special signs used in the panel system are shown in figure 34.

e. Example. Example of panel messages is shown in figure 35.

2. Ground-Air Visual Code for Use by Ground Search Parties

The symbols shown in figure 36 are standard signals used by ground search parties to communicate with friendly aircraft flying overhead.

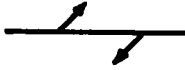
NR	MESSAGE	CODE SYMBOL
1.	OPERATION COMPLETED	LLL
2.	WE HAVE FOUND ALL PERSONNEL	<u>LL</u>
3.	WE HAVE FOUND ONLY SOME PERSONNEL	++
4.	WE ARE NOT ABLE TO CONTINUE. RETURNING TO BASE.	XX
5.	HAVE DIVIDED INTO TWO GROUPS. EACH PROCEEDING INTO DIRECTION INDICATED	
6	INFORMATION RECEIVED THAT AIRCRAFT IS IN THIS DIRECTION	→ →
7.	NOTHING FOUND. WILL CONTINUE TO SEARCH	NN

Figure 36. Ground-air visual code.

3. Ground-Air Emergency Code

a. The code shown in figure 37 is for emergency use by personnel who crash in aircraft or descend by parachute in remote areas, and who are in need of medical assistance, food, or information as to route to be taken in order to effect rescue. No indicators are used with this code since it is for emergency use only.

b. Code symbols can be made by using strips of fabric or parachute, pieces of wood, stones, or by tracking in the snow.

MEANING	SYMBOL
REQUIRE DOCTOR. SERIOUS INJURIES -----	I
REQUIRE MEDICAL SUPPLIES -----	II
UNABLE TO PROCEED -----	X
REQUIRE FOOD AND WATER -----	F
REQUIRE FIREARMS AND AMMUNITION -----	∇
REQUIRE MAP AND COMPASS -----	□
REQUIRE SIGNAL LAMP WITH BATTERY, AND RADIO -----	I I
INDICATE DIRECTION TO PROCEED -----	K
AM PROCEEDING IN THIS DIRECTION -----	↑
WILL ATTEMPT TAKE-OFF -----	I>
AIRCRAFT SERIOUSLY DAMAGED -----	L 7
PROBABLY SAFE TO LAND HERE -----	Δ
REQUIRE FUEL AND OIL -----	L
ALL WELL -----	LL
NO -----	N
YES -----	Y
NOT UNDERSTOOD -----	JL
REQUIRE ENGINEER -----	W

Figure 37. Ground-air emergency code.

APPENDIX XII

FIRE REQUESTS

1. Initial Fire Request

A complete discussion of fire requests is given in FM 6-40. Elements of the initial fire request are shown in table XV.

2. Subsequent Fire Request

A list of the elements of the subsequent fire is shown in table XVI.

Table XV. Initial Fire Request Elements

Element	Example
1. Identification of observer.....	Flagstaff 20 this is Flagstaff 61.
2. Warning order.....	Fire mission.
3. Reference point or target coordinates.	Reg point No. 1 or coordinates 123456.
4. Reference line.....	Reference line ALFA.
5. Location of target by shift (omitted for coord).	Left 150 add 600.
6. Nature of target.....	40 troops digging in.
7. Classification of fire (optional in ground arty; mandatory for naval gunfire).	Close (less than 600 yds; omitted for deep).
8. Type of adjustment.....	High angle.
9. Type of projectile.....	WP (omitted for shell HE).
10. Fuze action.....	VT (omitted for fuze quick).
11. Control.....	Will adjust.

Table XVI. Subsequent Fire Request Elements

Element	Example
1. Reference line.....	Reference line BRAVO.
2. Deviation.....	Right 80.
3. Height of burst.....	UP 20.
4. Trajectory.....	High angle.
5. Method of fire.....	Salvo right.
6. Distribution.....	Open sheaf.
7. Shell.....	Shell HE and WP.
8. Fuze.....	VT.
9. Range.....	Add 50.
10. Control.....	At my command fire for effect.

APPENDIX XIII

TECHNICAL CHARACTERISTICS OF ARMY AVIATION AVIONIC EQUIPMENT

1. Communications Equipment

See table XVII.

2. Navigational Equipment

See table XVIII.

3. Stabilization and Compass Equipment

See table XIX.

4. Joint Communication-Electronic Nomenclature System

See table XX.

Table XVII. Communications Equipment

Nomenclature	Frequency range in megacycles	Emission or reception	Frequency control	Number of channels	Approximate installed weight and volume	Remarks
AN/ARC-27 Radio Set	225-399.9	AM voice	Crystal	Any 18 preset of 1750, plus a single channel guard receiver.	95 lbs, 2 cu ft	Pressurized case for high-altitude operation.
AN/ARC-44 Radio Set	24-51.9	FM voice	Crystal	280	44 lbs, 1 cu ft	Nets with and homes on ground tactical sets. Includes AN/ARA-31 homing set.
AN/ARC-55 Radio Set	225-399.9	AM voice	Crystal	1750, plus a single channel guard receiver.	55 lbs, 2 cu ft	Unpressurized case version of AN/ARC-27 to be replaced by AN/ARC-51.
AN/ARC-59 Radio Set	2-18.5	AM voice	Crystal	Any 20 preset of 166	80 lbs, 3 cu ft	Long range air-to-air or air-to-ground communications set.
AN/ARC-60 () Radio Set	228-238	AM voice	Crystal	XMTR-16 preset receiver—continuous tuning.	26 lbs, 0.75 cu ft	UHF Rcvr—XMTR formed by adding two ARC type TV-10 frequency converter XMTR's to receiver R-508()/ARC.
ARC type 12 equipment	(*)	AM voice, MCW	Crystal	5 per XMTR receiver—continuous tuning.	Varies w/install	Includes combinations of R-507, R-508, R-509, R-510, R-511, T-363, T-364, T-365, T-366, and L-10 loop.
AN/ART-34 Transmitting Set, Radio.	118-135.95	AM voice	Crystal	360	36 lbs, 0.5 cu ft	VHF transmitter.
AN/ART-35 Transmitting Set, Radio.	118-135.9	AM voice	Crystal	180	22 lbs, 0.5 cu ft	VHF transmitter. Being phased out and replaced by AN/ART-34.
AN/FRC-15 Radio Set	25-50	FM voice	Crystal	2, within 250 kc of each other.	258 lbs, 12.1 cu ft	Ground nonfactual set used for aircraft control.
AN/FRC-27 Radio Set	152-174	FM voice	Crystal	2, within 500 kc of each other.	258 lbs, 12.1 cu ft	Back mounted with 1 or 2 R-394 receivers. For crash-rescue communications.
AN/GRC-27 Radio Set	225-399.9	AM voice	Crystal	Any 10 preset of 1750	1,200 lbs, 20 cu ft	Ground UHF set used for aircraft control.
AN/GRC-32 Radio Set	225-399.9	AM voice, MCW	Crystal	Any 18 preset of 1750	813 lbs, 8 cu ft	Ground UHF set for aircraft control. Uses basic components of AN/ARC-27.

AN/GRR-7 Radio Receiving Set.	225-399.9	AM voice.	Crystal.	1750.	50 lbs. 3 cu ft.	UHF radio receiver used in controlling aircraft.
AN/GRT-3 Radio Transmitting Set.	225-399.9	AM voice.	Crystal.	Any 1 preset of 1750.	400 lbs, 20 cu ft.	UHF nontactical transmitter used for aircraft control.
AN/PRC-8	20-28	FM voice.	VFO.	Continuous tuning.	34 lbs, 0.25 cu ft.	{ For airborne use until replaced by AN/ARC-44.
AN/PRC-9 Radio.	27-39		Crystal.			
AN/PRC-10 Set.	38-55		Calib.			
AN/TRC-42 Radio Set.	116-132	AM voice.	Crystal.	Single channel.	100 lbs, 2.8 cu ft.	Complete ground VHF radio telephone for ground-to-air use.
AN/URR-27 Receiving Set, Radio.	105-190	AM voice, MCW.	VFO plus 1 XTAL controlled channel.	Continuous tuning plus 1 preset.	63 lbs, 2.3 cu ft.	Ground nontactical VHF receiver used in controlling aircraft.
AN/URR-35 Receiving Set, Radio.	225-399.9	AM voice, MCW.	VFO plus 1 XTAL controlled channel.	Continuous tuning plus 1 preset.	63 lbs, 2.3 cu ft.	Ground nontactical UHF receiver used in controlling aircraft.

*0.19-0.55, 0.55-1.75, 108-135, 116-132, 118-148, 132-148.

Table XVIII. Navigation Equipment

Nomenclature	Frequency range in megacycles	Emission or reception	Frequency control	Number of channels	Approximate installed weight and volume	Remarks
AN/ARA-31 Antenna Group.		CW			6 lbs, 0.05 cu ft.	Antenna group with keyer. Normally used with AN/ARC-44 for homing.
AN/ARN-12 Marker Beacon Receiving Set.	75	AM, MCW	Crystal	Single channel	11 lbs, 0.25 cu ft.	Proposed substitute standard to be replaced by AN/ARN-35. Provides aural and single light visual indication.
AN/ARN-30A Receiving Set, Radio (omnirange receiver).	108-135.9	AM voice, MCW and phase difference.	VFO	Continuous tuning	30 lbs, 0.6 cu ft.	Airborne VHF omnidirectional range and localizer receiver, R-746()/AR.
AN/ARN-54 Receiving Set, Radio (radio compass).	0.19-0.44, 0.48-1.75.	AM voice, MCW, CW.	VFO	Continuous tuning	27 lbs, 0.4 cu ft.	Lear ADF-14B, modified.
AN/ORD-4 Radio Direction Finding Set.	100-156	AM voice, MCW	Crystal	8 preset	960 lbs	Ground DF set used in controlling aircraft. Weight includes 80-lb antenna and 544-lb mast.
AN/FRN-22 Transmitting Set, Radio (Terminal VOR Transmitter).	108-118	MCW and phase diff.	Crystal	1 preset of 100		Dual low power, terminal omnirange transmitter (TVOR) with automatic changeover switch.
AN/FRN-23 Beacon Radio (Marker Beacon Transmitter).	75	AM, MCW	Crystal	Single channel	Sheltered portion 194 lbs, 12 cu ft.	Wilcox TZY. Used by CAA.
AN/GRN-6 Beacon Set, Radio (LF homing transmitter).	30-39.9	FM, CW, MCW	VFO	Continuous tuning	1,550 lbs (less truck and power unit).	Mounted in shelter S-89/G and transported in ¾-ton truck, H-34 and H-21 helicopters without vertical antenna.
AN/URN-5 Beacon, Radio (LF homing Transmitter).	0.2-0.8	AM voice, MCW, CW.	Crystal	1 preset	1,500 lbs including shelter.	Nontactical LF/MF homing transmitter with voice facilities mounted in shelter.
R-510/ARC Receiver Radio (LF Range Receiver).	0.19-0.55	AM voice, MCW	VFO	Continuous tuning	9 lbs, 0.25 cu ft.	ARC type 12 low-frequency range receiver. ARC's R-11A (14V).
AN/FPN-33 Radar Set (GCA Radar).	9000-9200	Pulse	Magnetron	Continuous tuning	3,000 lbs.	Provides precision approach, surveillance, height finding, and taxi control. Will work up to 4 runways by switch selection.

R-511/ARC Receiver, Radio (LF Range Revr).	0.19-0.55-----	AM voice, MCW-----	VFO-----	Continuous tuning-----	9 lbs, 0.25 cu ft-----	ARC type 12 low-frequency range receiver. ARC's R-11A (28V).
R-746/AR Receiver, Radio (Gilde Slope Receiver).	329 9-335-----	AM, MCW-----	Crystal-----	20 preset-----	26 lbs, 0.5 cu ft-----	Airborne Gilde Slope Receiver Bendix MN-100A.

Table XIX. Stabilization and Compass Systems

Nomenclature	Frequency range in megacycles	Emission or reception	Frequency control	Number of channels	Approximate installed weight and volume	Remarks
AF type J-2 Slaved Gyro Compass System.	-----	-----	-----	-----	20 lbs, 0.2 cu ft-----	A slaved gyro magnetic compass system with a faster slave rate than that of the AN/ASN-13 used in helicopters.
AN/ASN-13 Gyro Magnetic Compass System.	-----	-----	-----	-----	10 lbs, 0.1 cu ft-----	A slaved gyro magnetic compass system similar to the Sperry J-2, but lighter.
F-5 Autopilot-----	-----	-----	-----	-----	60 lbs, 0.7 cu ft-----	Can be used with altitude and approach couplers.

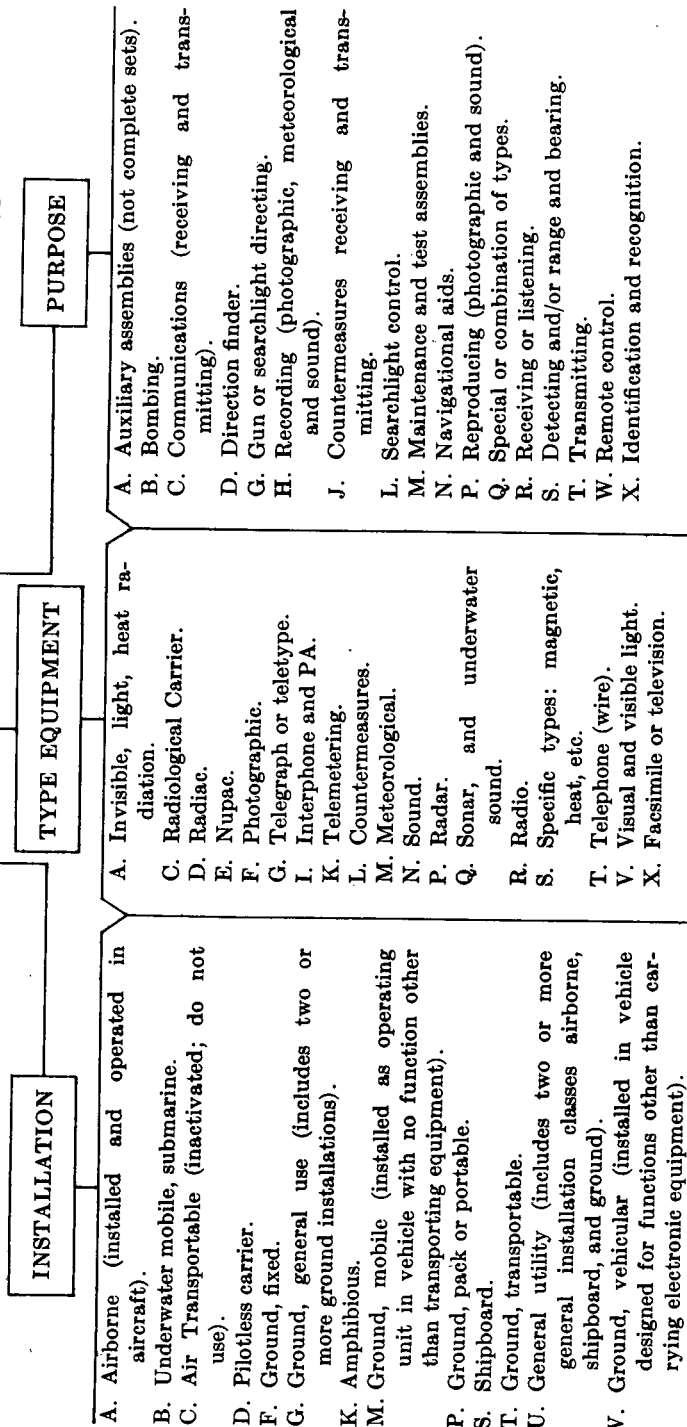
Table XX. Joint Communication-Electronic Nomenclature System

A N

A P G

13

Model Number of a
Specific Type

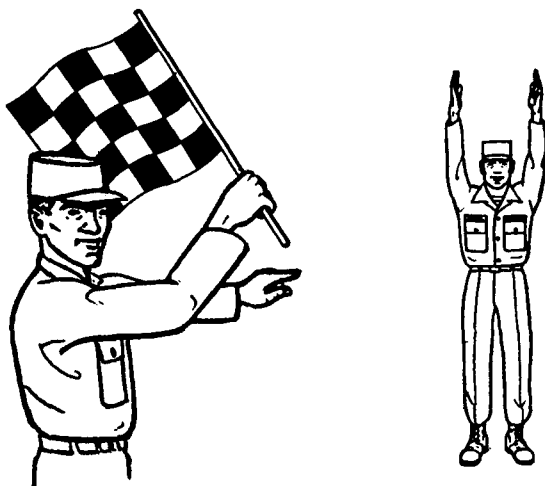


APPENDIX XIV

HAND SIGNALS

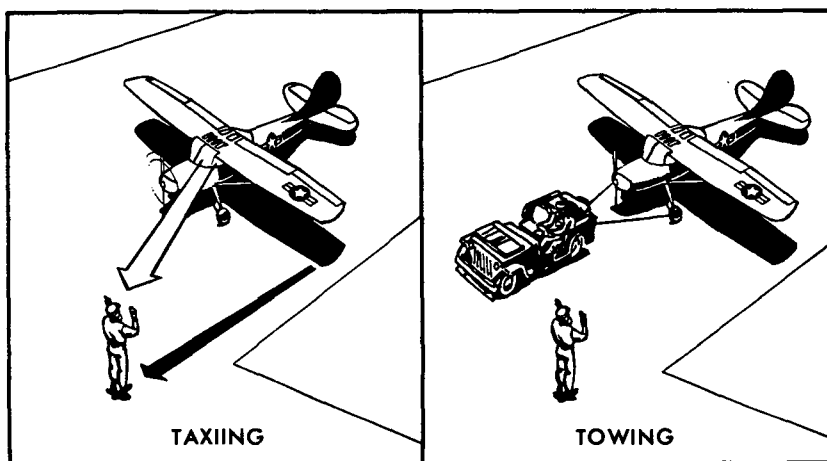
Hand signals for the operation and movement of aircraft on the ground have been agreed upon by all of the services.

Hand signals used for fixed wing and rotary wing aircraft are illustrated and explained in figures 38 and 39.



a. FLAGMAN AND TAXI SIGNALMAN

When required by the volume or nature of traffic, a flagman will be stationed on the landing field at a position far enough from the parking area to be clearly visible to pilot of approaching aircraft. By use of a distinguishing flag of black and white checks, the flagman will direct the pilot to the taxi signalman, who will indicate that he is ready to assume guidance of the aircraft by extending both arms perpendicularly at full length above his head, palms facing each other.



b. POSITION OF SIGNALMAN

The taxi signalman, when directing the movement of aircraft, will assume and maintain a position at all times from which the eyes of the pilot are visible. The position will be on a line extending directly forward from the left wing tip, except when the assumption of this position is rendered inadvisable by special conditions of the parking area. To direct the towing of the aircraft, the taxi signalman will assume the same position as that for directing the movement of the aircraft, with the addition that he must be visible to the driver of the towing vehicle at all times. When necessary, an additional crewman will be stationed at the right wing tip. This crewman will remain visible at all times to the taxi signalman to whom he will direct all necessary signals.

Figure 38. Fixed wing aircraft hand signals.



c. COME AHEAD

The taxi signalman will direct the pilot to taxi forward by raising both hands before him to eye level, with elbows flexed and palms turned toward face, and executing beckoning motions therewith. The rapidity of the hand motions will indicate the speed desired of the aircraft.



f. STOP

To direct the pilot to stop, the taxi signalman will raise both hands before him to eye level, elbows flexed and palms turned toward the aircraft, in a policeman's stop.



d. RIGHT TURN

To direct the pilot to turn right, the taxi signalman will execute the "Come Ahead" signal with his right hand and at the same time will point with his left hand to the wheel which is to be braked (right wheel of aircraft).



g. EMERGENCY STOP

The emergency stop signal is executed by raising the arms above the head, palms turned toward the aircraft and moving the arms from side to side, crossing above the head.



e. LEFT TURN

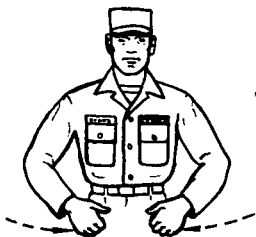
To direct the pilot to turn left, the taxi signalman will execute the "Come Ahead" signal with left hand and at the same time will point with his right hand to the wheel which is to be braked (left wheel of aircraft).



h. CUT ENGINES

To direct the pilot to cut engines, the taxi signalman will draw the extended forefinger of one hand across his neck in a "throat cutting" motion. If it is desired that a specific engine of a multi-engine aircraft be cut, the taxi signalman will execute the above signal and at the same time will point with the other hand to the appropriate engine.

Figure 38—Continued.



i. INSERT CHOCKS

To direct the insertion of chocks, the taxi signalman will sweep fists together at hip level with thumbs extended and pointing inward.



j. START ENGINE

Pilot sets parking brakes prior to starting engines. He verbally informs the taxi signalman or extends the number of fingers in direction of desired engine. The taxi signalman will point the same number of fingers at the proper engine and rotate the other hand in a clockwise circling motion if all is clear.



k. PULL CHOCKS

Pilot will recheck the setting of the parking brake, will then signal for chock removal by an outward sweeping motion of the fist, with thumb extended and pointing outward. The taxi signalman will acknowledge the signal with a sweep of the fists away from each other at the hip level with thumbs extended and pointing outward.



l. ALL CLEAR

The all clear signal will be initiated by the pilot to indicate his desire to begin taxiing and will be made by touching the tip of the index finger with the tip of the thumb and the remaining fingers extended. The taxi signalman will respond with a similar gesture if all is clear to taxi.

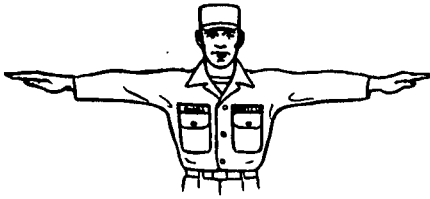
NIGHT OPERATIONS

Where field illumination permits, the taxi signalman during hours of darkness will station himself in a lighted area and will execute the foregoing signals as prescribed. In the absence of a suitably lighted area the foregoing signals will be executed by employing suitable illuminated wands (or flash lights, if the wands be not obtainable) one to be held in each hand of the signalman. Signals used when employing wands or flash lights will be identical with the foregoing except that the "Emergency Stop" signal will be made by crossing wands or beams of flash lights before the face of the signalman. Care will be exercised throughout to avoid flashing lights in the eyes of the pilot.



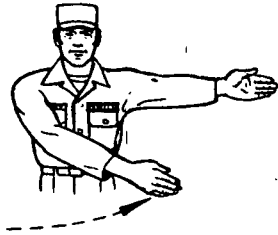
m. EMERGENCY STOP (Night Operations)

Figure 38—Continued.



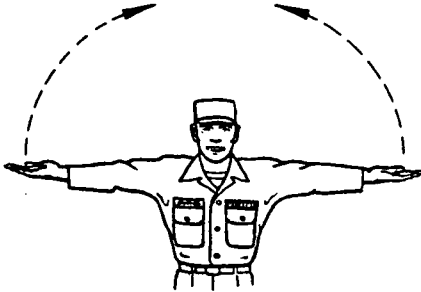
a. HOVER

Arms extended horizontally sideways.



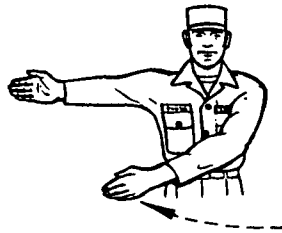
d. MOVE RIGHT

Left arm extended horizontally sideways. Right arm swing in front of body to indicate direction of movement, repeating.



b. MOVE UPWARDS

Arms extended horizontally, to the side beckoning upwards, with palms turned up. Speed of movement indicates rate of ascent.



e. MOVE LEFT

Right arm extended horizontally sideways. Left arm swing in front of body to indicate direction of movement, repeating.



c. MOVE DOWNWARDS

Arms extended horizontally, to the side beckoning downwards with palms turned down. Speed of movement indicates rate of descent.



f. LAND

Arms crossed and extended downwards in front of the body.

Figure 39. Rotary wing aircraft hand signals.



g. APPROACH

Arms extended above head, palms in, indicates helicopter glide path is good. Continue approach.



j. MOVE FORWARD

Horizontal movement of hands toward the body, palms in, indicates move helicopter forward.



h. MOVE REARWARD

Horizontal movement of hands away from body, palms out, indicates move helicopter to the rear.



k. HOLD

Arms held steady, extended forward and upward with fists tightly clenched.



i. RELEASE SLING LOAD

Forearm and hand horizontal to the ground with hand across throat means release sling load.



l. TAKEOFF

Pointing in direction of takeoff means the helicopter is ready for takeoff.

NOTE: NIGHT SIGNALS are performed in the same manner as day signals except that an illuminated wand is held in each hand. The HOLD signal is indicated by crossing wands in front of face.

Figure 39—Continued.

APPENDIX XV

AIRCRAFT TRANSPORTATION

1. Disassembly for Air Cargo Shipment of Fixed Wing Aircraft

See table XXI.

2. Disassembly for Air Cargo Shipment of Rotary Wing Aircraft

See table XXII.

3. Basic Data for Army Aircraft

See table XXIII.

4. Highway Clearance Problems

See table XXIV.

5. Disassembly for Motor and Rail Shipment of Fixed Wing Aircraft

See table XXV.

6. Disassembly for Rail and Motor Shipment of Rotary Wing Aircraft

See table XXVI.

Table XXI. Fixed Wing Aircraft Disassembly for Air Cargo Shipment

Airplane	Type of cargo aircraft	Fuselage shipped on—	Remove						
			Propeller	Horizontal stabilizer	Elevators	Vertical stabilizer	Rudder	Wings	Battery
Bird Dog	C-119	Landing gear	Optional	Yes	Yes	No	No	Yes	No.
	C-123	Landing gear	Optional	Yes	Yes	No	No	Yes	No.
	C-124	Landing gear	Optional	Optional	Optional	No	No	Yes	No.
	C-130	Landing gear	Optional	Optional	Yes	No	No	Yes	No.
Beaver	C-119	Cradle	Yes	Yes	Yes	Yes	Yes	Yes	No.
	C-123	Optional	Optional	Yes	Yes	Yes	Yes	Yes	No.
	C-124	Landing gear	Optional	Yes	Yes	No	No	Yes	No.
	C-130	Cradle	Optional	Yes	Yes	No	No	Yes	No.
Seminole	C-119	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
	C-123	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
	C-124	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
	C-130	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
Otter	C-119	Cradle	Yes	Yes	Yes	Yes	Yes	Yes	No.
	C-123	Cradle	Yes	Yes	Yes	Yes	Yes	Yes	No.
	C-124	Cradle	Yes	Yes	Yes	Yes	Yes	Yes	No.
	C-130	Cradle	Yes	Yes	Yes	Yes	Yes	Yes	No.

¹ Cannot be shipped economically.

Table XXII. Rotary Wing Aircraft Disassembly for Air Cargo Shipment

Helicopter	Type of cargo aircraft	Fuselage shipped on—	Remove					
			Tail cone	Tail pylon	Rotor blades	Stabilizers	Battery	Other
Sioux	C-119	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-123	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-124	Landing gear	No	No	Yes	No	No	None.
	C-130	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-119	Cradle	Yes	Optional	Yes	Optional	No	Canopy, cow, and transmission.
Chickasaw	C-123	Cradle	Yes	Optional	Yes	Optional	No	Canopy, cowl, and transmission.
	C-124	Cradle	Yes	Optional	Yes	Optional	No	None.
	C-130	Cradle	Yes	Optional	Yes	Optional	No	Main rotor mast.
	C-119	(1)	(1)	(1)	(1)	(1)	(1)	
	C-123	(1)	(1)	(1)	(1)	(1)	(1)	
Shawnee	C-124	Cradles	Yes	NA	Yes	Yes	No	None.
	C-130	Cradles	Yes	NA	Yes	Yes	No	Both transmissions and cowl.
	C-119	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-123	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-124	Landing gear	No	No	Yes	No	No	None.
Raven	C-130	Landing gear	No	No	Yes	No	No	Rotor hub.
	C-119	(1)	(1)	(1)	(1)	(1)	(1)	
	C-123	(1)	(1)	(1)	(1)	(1)	(1)	
	C-124	Cradle	Yes	Yes	Yes	Yes	No	Main rotor hub.
	C-130	Cradle	Optional	Yes	Yes	Yes	No	Transmission and canopy assembly.
Choctaw	C-119	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-123	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-124	Landing gear	No	No	Yes	No	No	None.
	C-130	Landing gear	No	No	Yes	No	No	Rotor hub.
	C-119	(1)	(1)	(1)	(1)	(1)	(1)	
Choctaw	C-123	(1)	(1)	(1)	(1)	(1)	(1)	
	C-124	Cradle	Yes	Yes	Yes	Yes	No	Main rotor hub.
	C-130	Cradle	Optional	Yes	Yes	Yes	No	Transmission and canopy assembly.
	C-119	Landing gear	No	No	Yes	No	No	Main rotor mast.
	C-123	Landing gear	No	No	Yes	No	No	Main rotor mast.

Table XXII. Rotary Wing Aircraft Disassembly for Air Cargo Shipment—Continued

Helicopter	Type of cargo aircraft	Fuselage shipped on—	Remove					Other
			Tail cone	Tail pylon	Rotor blades	Stabilizers	Battery	
Mojave-----	C-119----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	
	C-123----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	
	C-124----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	
	C-130----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	
Iroquois-----	Landing gear----	-----	No-----	Yes-----	Yes-----	Yes-----	No-----	Main rotor mast.
	Landing gear----	-----	No-----	Yes-----	Yes-----	Yes-----	No-----	Main rotor mast.
	Landing gear----	-----	Yes-----	Optional	Yes-----	Yes-----	No-----	None.
	Landing gear----	-----	No-----	Yes-----	Yes-----	Yes-----	No-----	Main rotor mast.

1 Cannot be shipped economically.

Table XXIII. Basic Data For Army Aircraft

A. Fixed wing aircraft		Brd Dog	Beaver	Seminole	Otter
Weight, empty, pounds	-----	1, 500	3, 165	4, 015	4, 670
Length:	-----				
(1) Flight attitude	-----	25'11"	30'4"	31'6"	41'10"
(2) On ground	-----	25'0"	30'4"	31'6"	42'0"
Height:	-----				
(1) Propeller horizontal	-----	7'6"	12'6"	11'4"	12'7"
(2) Propeller vertical	-----	9'2"	10'5"	11'4"	13'0"
Width:	-----				
(1) With wings	-----	36'0"	48'0"	45'3"	58'0"
(2) Without wings	-----	3'11"	4'4"	16'3"	5'2"
Service ceiling, feet	-----	22, 900	20, 000	19, 000	20, 000
Cruising speed, knots	-----	82	109	139	100
Fuel per hour, gallons	-----	6. 5	18. 5	23. 8	26. 0
Service life, years	-----	6	8	8	-----
Flyaway costs, dollars	-----	10, 200	39, 956	78, 450	89, 570

Table XXIII. Basic Data For Army Aircraft

B. Rotary wing aircraft	Sioux	Chickasaw	Shawnee	Raven	Choctaw	Mojave	Iroquois
Weight, empty, pounds-----	1, 535	4, 895	8, 480	1, 735	7, 205	19, 710	3, 345
Length:							
(1) Rotor blades extreme positions-----	41'3"	62'6"	86'4"	40'6"	65'11"	82'10"	53'0"
(2) Rotor blades folded or removed-----	30'2"	42'1"	52'6"	28'2"	44'2"	53'8"	39'7"
Height:							
(1) Tail rotor blades vertical-----	8'9"	14'7"	NA	9'6"	16'0"	21'6"	14'7"
(2) To top of main rotor-----	9'1"	13'5"	16'0"	9'6"	14'2"	16'9"	12'0"
Width:							
(1) Rotor disc diameter-----	35'2"	53'0"	44'0"	35'0"	56'0"	68'0"	44'0"
(2) Rotor blades folded or removed-----	8'7"	11'6"	14'6"	7'6"	12'0"	27'4"	8'4"
Service ceiling, feet-----	13, 000	15, 500	10, 800	10, 000	-----	-----	22, 000
Cruising speed, knots-----	52	80	83	52	90	-----	100
Fuel per hour, gallons-----	11.1	35.8	77.1	11.5	70.0	195.0	38.8
Service life, years-----	10	10	-----	10	-----	-----	-----
Flyaway costs, dollars-----	32, 394	136, 668	357, 563	36, 453	216, 500	846, 772	-----

Table XXIV. Highway Clearance Problems

A. Height Aircraft	How loaded	Maximum height exceeded by approximately—	Solution
Sioux.....	Landing gear.....	6 inches.....	Remove main rotor mast.
Chickasaw.....	Cradles (3).....	24 inches.....	Remove canopy, cowl, and transmission.
Shawnee.....	Cradles (2).....	36 inches.....	Remove transmissions. ¹
Raven.....	Landing gear.....	6 inches.....	Remove main rotor mast.
Choctaw.....	Cradles (3).....	54 inches.....	Remove transmission and canopy assembly.
Iroquois.....	Cradles (3).....	22 inches.....	Remove main rotor mast.
¹ With these components removed, maximum height is still exceeded for a 53-inch loading height. The problem may be solved by use of low-bed trailers or by selecting a route where minimum clearances will not be encountered.			
B. Width Aircraft	How loaded	Maximum height exceeded by approximately—	Solution
Choctaw.....	Cradles (3).....	6 inches.....	Reduce overall width of shipping cradle. ²
Mojave.....	Cradle.....	19 feet.....	No practical solution.
Beaver.....	Cradle.....	12 inches.....	Reduce overall width of shipping cradle. ²
Seminole.....	Cradle.....	8 feet.....	No practical solution.

² Reduction in overall width of the shipping cradle can be accomplished by reducing the distance between the skids. (Fig. 48a-1).

Table XXV. *Fixed Wing Aircraft Disassembly for Motor and Rail Shipment*

Airplane	Type of transport	Fuselage shipped on---	Remove						
			Propeller	Horizontal stabilizer	Elevators	Vertical stabilizer	Rudder	Wings	Battery
Bird Dog-----	Rail-----	Landing gear-----	Optional-----	Yes-----	Yes-----	No-----	No-----	Yes-----	Yes.
Beaver-----	Motor-----	Landing gear-----	Optional-----	Yes-----	Yes-----	No-----	No-----	Yes-----	Yes.
	Rail-----	Cradle-----	Optional-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes.
Seminole-----	Motor-----	Cradle-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes.
	Rail-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1).
Otter-----	Motor-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1)-----	(1).
	Rail-----	Cradle-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes.
	Motor-----	Cradle-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes-----	Yes.

(1) Cannot be shipped economically.

Table XXVI. Rotary Wing Aircraft Disassembly for Rail and Motor¹ Shipment

Helicopter	Type of transport	Fuselage shipped on—	Remove					
			Tail cone	Tail pylon	Rotor blades	Stabilizers	Battery	Other
Sioux.	Rail	Landing gear	No	No	Yes	No	Yes	None.
	Motor	Landing gear	No	No	Yes	No	Yes	None.
Chickasaw	Rail	Cradle	Yes	Yes	Yes	Yes	Yes	None.
	Motor	Cradle	Yes	Yes	Yes	Yes	Yes	None.
Shawnee	Rail	Cradles	Yes	(?)	Yes	Yes	Yes	None.
	Motor	Cradles	Yes	(?)	Yes	Yes	Yes	Rotor transmissions.
Raven.	Rail	Landing gear	No	No	Yes	No	Yes	None.
	Motor	Landing gear	No	No	Yes	No	Yes	None.
Choctaw	Rail	Cradle	Yes	Yes	Yes	Yes	Yes	Rotor mast.
	Motor ¹	Cradle	Yes	Yes	Yes	Yes	Yes ²	Rotor mast.
Mojave	Rail	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	
	Motor	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	
Iroquois	Rail	Landing gear	No	No	Yes	No	Yes	Rotor mast.
	Motor	Cradle	Yes	Yes	Yes	Yes	Yes	Rotor mast.

¹ Utilizing a low-bed trailer.

² Not applicable.

³ Maximum height permissible for unrestricted travel exceeded by approximately 24 inches.

⁴ Cannot be shipped economically.

APPENDIX XVI

RESUPPLY EQUIPMENT AND TECHNIQUES

1. Parachutes and Containers

a. General. In general, equipment needed for parachute delivery of equipment and supplies by Army aircraft is divided into two main categories: parachutes and containers. When standardized equipment is not available, improvised equipment can be used. The parachutes and containers described below can be utilized with fixed and rotary wing aircraft. Specific procedures for parachute delivery of supplies and equipment are prescribed in TM 10-500-series.

b. Cargo Parachutes. The most common cargo parachute for Army aircraft use is the G-13. This parachute is, at present, supplied to the infantry and airborne divisions only. The G-13 parachute has a 24-foot canopy and will support up to 500 pounds of cargo at 175 mph or less, with an average descent rate from 17 to 35 feet per second. It weighs 45 pounds when packed and has a 35-foot static line which must be reduced to 15 feet in length for use with Army aircraft to avoid fouling in rotors or control surfaces. The G-13 also comes in six colors and is used with the A-5, A-7, A-7A, and A-21 containers.

c. Containers. The use of containers facilitates packing, damage prevention, handling, and collection of airdropped supplies. Normally supplies are dropped from Army aircraft on an emergency or priority basis; consequently every precaution must be exercised to insure safe, accurate delivery of the supplies. Precautions should be taken in packing all types of containers to insure that they (1) eject and drop properly and (2) are undamaged when the parachutes open and when the containers strike the ground. The three principles followed in the packing of containers are:

- (1) *Avoid splitting loads.* Because of the wide ground pattern that may result from dropping and the consequent loss of time in retrieving items useful only in combination, great care should be taken in splitting loads.
- (2) *Pad loads.* Procedures for padding loads dropped by air vary because of containers and increased loads. In packing fragile loads, however, each item should be individually wrapped.

- (3) *Secure loads.* The strap holding the loads in the containers should be so secured as to be easily released. All excess strap should be accordion-folded and snubbed with tape, rubber bands, or cord to prevent entanglement when the containers are ejected from the aircraft.

d. Types of Containers. Containers normally utilized by Army Aviation units are the A-5, A-7A, and the A-21.

- (1) The A-5 aerial delivery cargo roll (fig. 40) is made of duck and consists of a cargo body container and two end covers. The container weighs 43 pounds and can deliver a maximum of 300 pounds of miscellaneous supplies and equipment. It may be delivered from the aircraft door or from bomb shackles.
- (2) The A-7A aerial delivery cargo sling is composed of four 188-inch straps made of type 10 cotton webbing. The total weight of the container is 8 pounds. The A-7A is capable of delivering a maximum load of 500 pounds. A two-strap sling (fig. 41a) normally will deliver 300 pounds; a three-strap sling (fig. 41b), 400 pounds; and a four-strap sling (fig. 41c), 500 pounds. Common loads include ammunition, water cans, rations, and fuel drums. The container may be delivered from the aircraft door or from bomb shackles.
- (3) The A-21 aerial delivery cargo bag (fig. 42) is an adjustable, open-type duck and webbing sling assembly with quick release assembly and canvas cover. The container weighs 31 pounds and can deliver a maximum load of 500 pounds. Common loads include ammunition, rations, and weapons and delivery is by the door load system or by external sling.

2. Bomb Shackles

Bomb shackles can be mounted on fixed wing aircraft in pairs on the underside of each wing. Any bundle supported by shackles may be released by a mechanical or an electrical tripping mechanism in the cockpit. Contrary to the cargo door outloading method, an observer is not required when using bomb shackles. Bundles may be released individually or together by the pilot. A safety feature built into the shackle mechanism allows the pilot to jettison his load if the tripping mechanism or one or more of the shackles becomes inoperative.

3. Roller Conveyors

When large containers such as the A-21 must be dropped, roller conveyors may be used. The conveyor is lashed to the floor of the

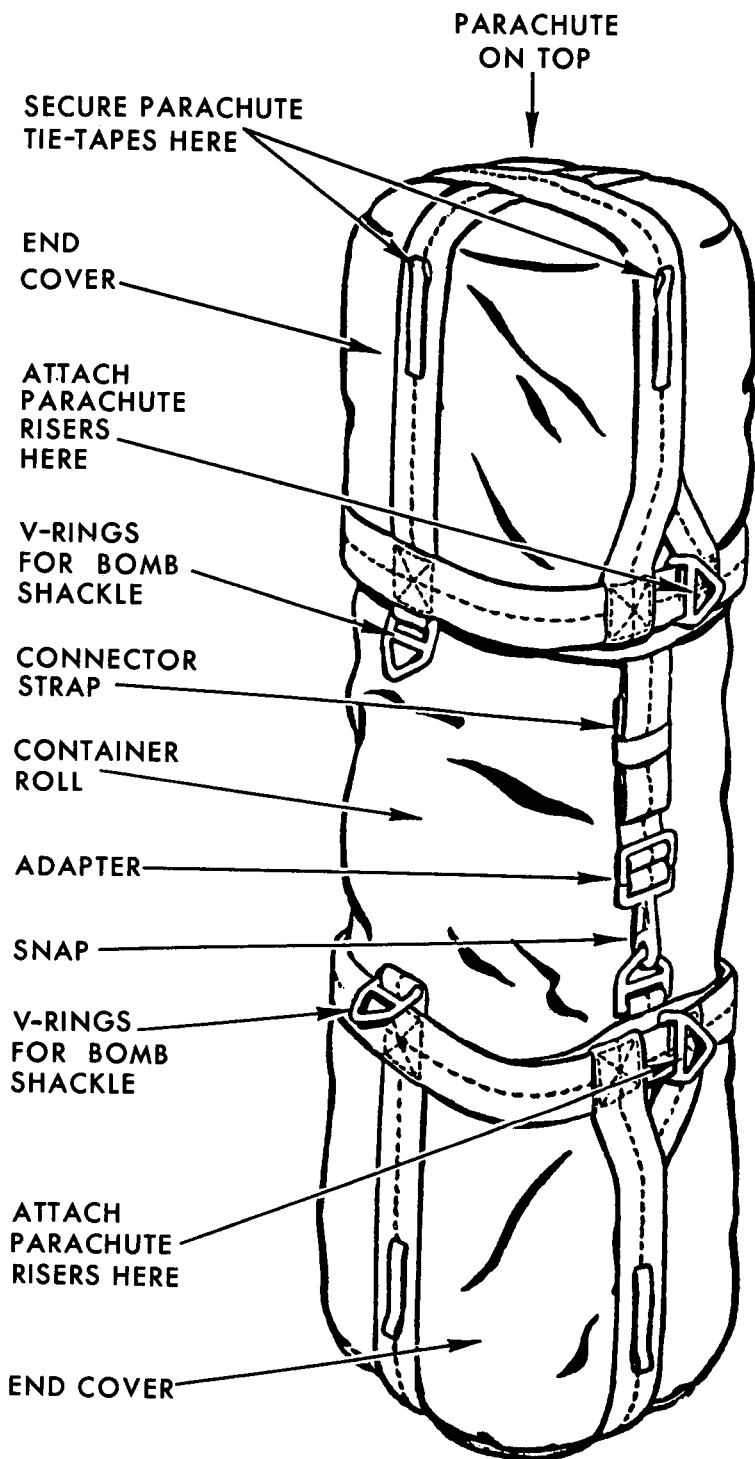


Figure 40. A-5 aerial delivery cargo roll.

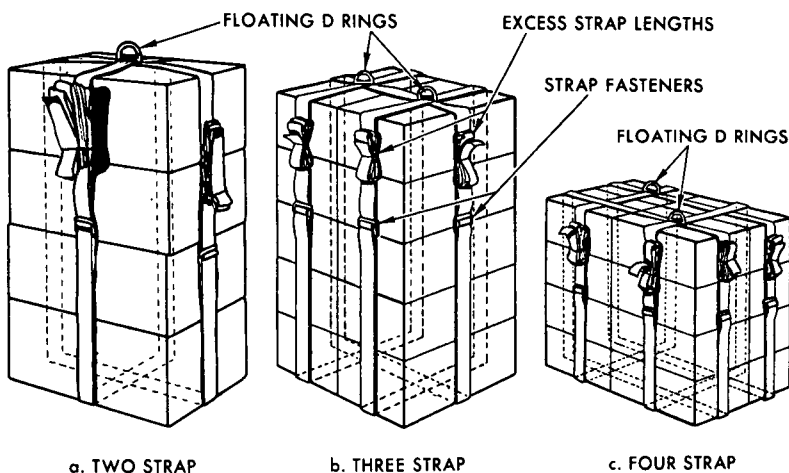


Figure 41. A-7A aerial delivery cargo sling.

aircraft with wire or rope. It should be lashed at an angle to the long axis of the cargo compartment to facilitate delivery of the load through the door. For accurate delivery of door bundles, ejection must be as rapid as possible upon receipt of pilot's signal.

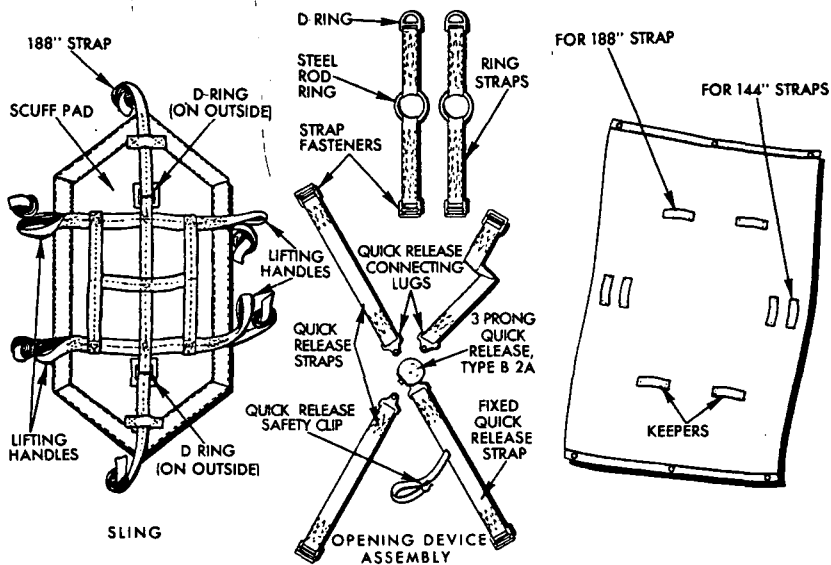
4. Monorails

Monorails provide a fast and efficient method of out-loading supplies. Bundles mounted on the monorail are ejected in much less time than required for manual ejection; however, the added weight of the monorail reduces the payload which can be carried. The possibility of entangling loads is also less likely.

5. Weights and Positions of Loads

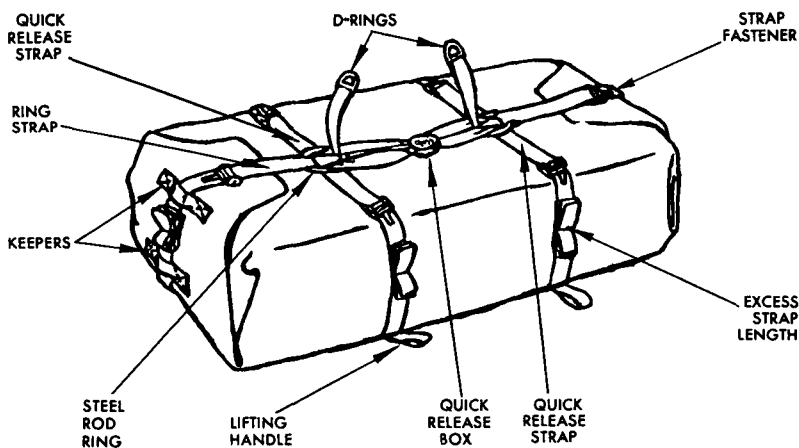
a. Load weights vary with the power and structural strength of the aircraft being used. Overall weight must remain within the maximum load-carrying capacity listed as safe for the particular aircraft; the individual load at each suspension point must be kept within the support capacity of the structural members bearing the weight. Since floors of Army aircraft are light construction, care must be exercised to prevent damage to them. If loads of high density (106-mm rifles, 4.2 mortars, etc.) and small contact area are loaded, shoring must be used to prevent puncture of the floor. This is especially true for rotary wing aircraft. Shoring can be made of plywood and should be provided by the unit being transported.

b. The cargo must not displace the aircraft center of gravity beyond safe limits. External loads carried by fixed wing aircraft must be distributed equally on each wing. Attaching sling loads



a. SLING ASSEMBLY

b. CANVAS COVER



c. CONTAINER PACKED AND SECURED

Figure 42. A-21 aerial delivery cargo bag.

to rotary wing aircraft is relatively simple since the center of gravity of the aircraft will remain constant.

6. Lashing

Cargo inside the aircraft must be restrained against motion in all directions (for restraint factors, see -9-series of T.O.'s). In general, sufficient lashings should be applied to the load to prevent motion in any direction and to provide reasonable safety in the event of an emergency landing.

7. Flight Characteristics of Loaded Aircraft

a. *Fixed Wing.* A loaded fixed wing aircraft reacts more sluggishly to its controls than one not loaded. Takeoff distance is materially increased. The additional weight, plus the drag created by external loads, increases the stalling speed of the aircraft. When using bomb shackles to drop bundles, the flying speed should be kept well above the rated stalling speed to provide for positive control if a portion of the load should fail to disengage. Only gentle maneuvers should be attempted.

b. *Rotary Wing.*

- (1) *Internal loads.* If rotary wing aircraft are properly loaded internally (taking the center of gravity into consideration), little change occurs in flight characteristics. Two differences that should be considered are that (1) increased power is required for flight, thus reducing reserve power, and (2) forward speeds must be reduced because of the danger of retreating blade stall.
- (2) *External loads.* Rotary wing aircraft usually must hover over a load to pick it up and to set it down in delivery. More power is necessary and thus decreases reserve power. The forward speed must be decreased when carrying a sling load for two important reasons: First, to reduce the chance of retreating blade stall; second, to reduce erratic swinging of unstable loads and consequent pitch or roll. This sway tendency is especially true during high forward speeds and can become so pronounced that the pilot may have to jettison the load.

APPENDIX XVII

MESSAGE DROP AND PICKUP METHODS AND TECHNIQUES

1. Message Drop

a. Scheduled Service. As the scheduled aircraft approaches the unit for which the message is intended, it gives a prearranged pyrotechnic or other signal call for a display of panels. Ground units, in response, display identification and unit designation panels (app. XI) in an area previously selected. This area should be located in an open space free of obstacles. When unit location is well known and in a rear area, the message may be dropped without a request for display of ground panels. To acknowledge receipt of message, ground troops display prearranged panels or wave the message bag or container.

b. Unscheduled Service. Unscheduled messages which warn of ambushes, mined roads and bridges, and concentration of enemy forces may be dropped with or without prearranged signals. When an unscheduled message is dropped at a command post, it is retrieved like a scheduled message and delivered to the message center.

c. Equipment. A message bag or container, such as message bag 121 or message container A-8, is the only equipment needed for message drop. If this is unavailable, a bag or cylindrical container of heavy cloth, an empty hand grenade, or a shell container may be used. A brightly colored streamer, 6 feet by 2 inches, should be added to such a container. If necessary, enough sand to make the container fall straight, and enough cork, dry wood, or kapok for buoyancy if it lands on water, should be added.

2. Message Pickup

a. Pole Method. If time permits, two poles 12 to 15 feet high (usually lance poles) are erected at the selected field or clearing. The two poles may be held erect if necessary. Two sets of panels (fig. 43), one marking the site and the other the direction of the wind, (smoke grenades may be used) are placed one panel length apart in front of the poles. An area of 50 feet or more from the

side of either panel marking the site is considered dangerous. Approaches should be at least 300 feet long. The message bag is attached to the center of a strong cord connecting the two poles. The aircraft, trailing a grapnel (fig. 43) flies low over the field and picks up the cord. Direction of the wind must be carefully determined by ground personnel since the pilot must rely largely on their information.

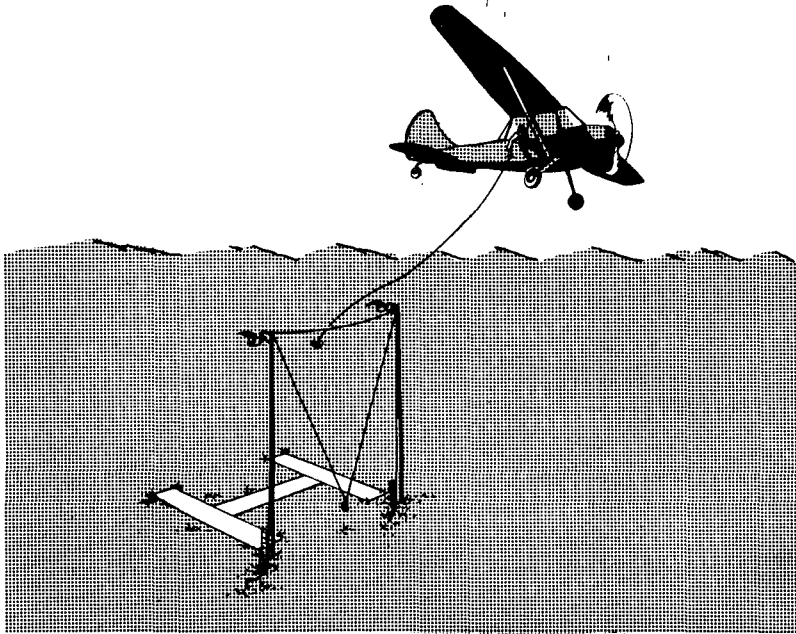


Figure 43. Message pickup—the pole method.

b. Modified Pole Method. If poles are not readily available or there is insufficient time, two men may hold the string up tautly between them. They should stand at least 20 feet apart and face the approaching aircraft. The cord is held between thumb and index finger with the arm extended vertically. This permits elevating or lowering the cord as much as three feet. A short stick or a rifle may be used to gain additional height. If a rifle is used, it should be held upward with the sight turned away from the approaching aircraft and the cord placed on top of the front sight.

c. Throw Method. Panels are laid out on the ground to mark the pickup position and to indicate to the aviator the direction of approach. Two men, each holding a sandbag (weighing one-quarter pound or less) connected by a cord or rope, stand at the ends of the panel away from the approaching aircraft. The message is attached to one of the weighted bags. At the right moment, by

prearranged signal from one of the men, the bags are thrown (fig. 44) into the air in such a manner that the cord connecting them is caught by the grapnel trailing from the aircraft. The bags are then hauled in by the observer. Because of the hazard involved, this technique is used only when the pole method or the modified pole method is not possible. When it is used, the grapnel should extend at least 50 feet below the aircraft.

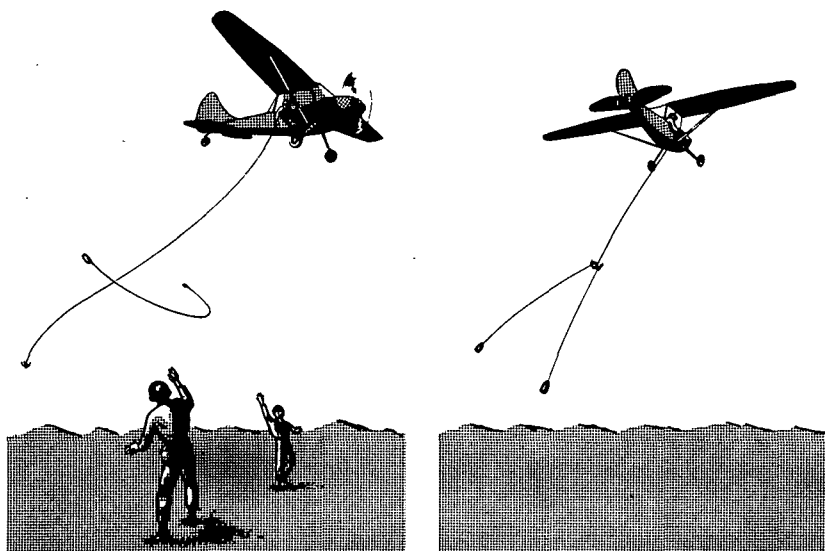


Figure 44. Message pickup—the throw method.

d. Signal Man. The pilot is guided by a signal man, when available, who stands to one side of the flight path so that the pickup cord is between the signal man and the aircraft (fig. 45). The pilot is then signaled to go up or down, right or left, so that the grapnel engages the pickup cord.

Caution: The grapnel should never be allowed to strike a tree, a limb, or the ground. The pickup string must be held so that it may be dropped instantly. It should never be wrapped around the hand or fingers. Due to the danger of being struck by the grapnel, it is mandatory that all ground personnel wear helmets during a message pickup.

e. Pilot Technique. A message pickup approach is identical to a normal 180° power-off landing approach. Opposite the pickup point, power is reduced, flaps are lowered, and a normal glide is established. Round-out to level flight attitude is started just short of the pickup point with enough power added to maintain flying speed. Normally, the pilot is responsible for adjusting the height of the

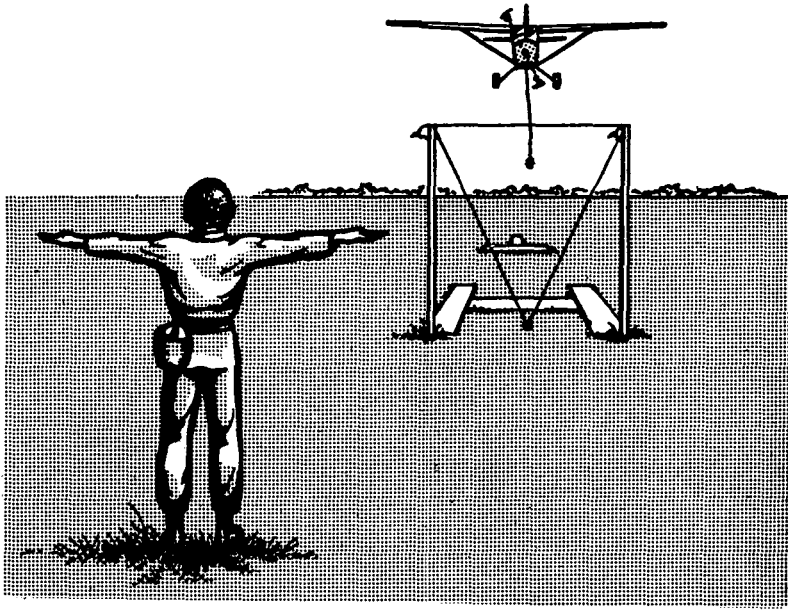


Figure 45. The signal man.

aircraft and the observer with positioning the grapple at the proper elevation above the ground to engage the cord with attached message bag. The aircraft should pass just over the string in a level flight attitude. As the string is engaged, full power is added and normal climb initiated.

APPENDIX XVIII

WIRE LAYING EQUIPMENT AND TECHNIQUES

1. Wire Laying Equipment for Army Aircraft

a. Wire. The only wire approved for aerial wire laying is the WD-1/TT type, which is a seven-strand steel and copper wire with an inner insulation of polyethylene and an outer jacket of extruded nylon.

b. Wire Dispensers. The MX-306/AG dispenser is the latest model of wire dispenser developed. Each dispenser contains about one-half mile of wire WD-1/TT weighing approximately 23½ pounds. Four dispensers can be mounted in tandem and mounted in wire dispenser case CY-1064/ATC. Wire can be payed out at speeds up to 100 mph without danger of backlash; however, slower speeds are desirable.

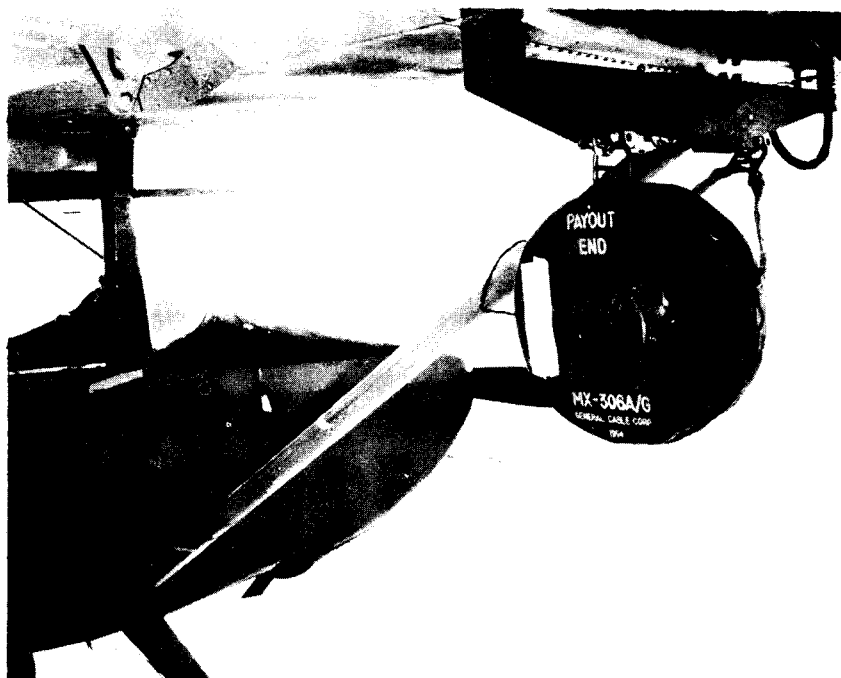
c. Containers for Wire Dispensers. Lightweight containers only hold the dispensers in alinement and prevent the wire from snarling or twisting while the aircraft is in flight. The containers are held in the bomb shackles of fixed wing aircraft (fig. 46) so that the aviator may jettison them when required.

2. Wire Laying Technique

a. General. Before the wire mission is begun, a thorough wire route reconnaissance should be made and terrain features marked on maps to designate the flight path. Road and railroad crossings should be noted and ground personnel placed and alerted for the purpose of securing wire at crossings. Such obstacles can at times be avoided by laying wire across the tops of trees in the area. *Wire should never be laid across power lines.* Long, unsupported spans of wire will break if the weight of the wire span exceeds the tensile strength of the wire.

b. Fixed Wing Aircraft.

- (1) Two containers are used, one on each side of the aircraft. Each container, attached to a bomb shackle, holds four dispensers. If a single circuit four miles long is desired, the payout end of the second container is connected to the standing end of the first container and the wire connect-



a. CLOSE UP



b. DISTANT VIEW

Figure 46. Wire dispenser mounted on bomb shackle.

ing the two is passed under the fuselage of the aircraft. The first container is jettisoned before all of its wire is payed out to allow free payout from the second container. For wire lines of less than $1\frac{1}{2}$ miles the appropriate number of dispensers are spliced together and the container filled with sealed dispensers.

- (2) Fixed wing aircraft must maintain maximum stability of flight when laying two wire circuits simultaneously. The starting point of the route is determined by the direction of the wind. Fixed wing aircraft flying at low altitudes should head into the wind. At the start of the route, the aviator flies low and drops the weighted payout end of the line. The aviator, flying as low as possible, follows his selected route to the end of the wire lines. Since the aviator cannot cut the wire, flight is continued until all wire has ben released. If used, expendable wire dispensers may be dropped at the terminus.

c. Rotary Wing Aircraft. At the beginning of the wire line, the rotary wing aircraft descends to ground level and the payout end of the line is secured. Paying out wire as it goes, the rotary wing aircraft flies at a minimum safe altitude to the terminus. There it reduces its forward speed and descends to ground level. The necessary slack is unreeled and the wire is cut. Light and medium transport rotary wing aircraft can dispense wire directly from the cargo compartment.

Warning: To prevent entangling the wire in the tail rotor blade, the rotary wing aircraft should be flown so that there is a 30° to 45° clearance angle between the longitudinal axis of the aircraft and the dispensing wire. To accomplish this in wind (with the exception of a direct headwind or a direct tailwind), the wire dispenser must be attached to the upwind side of the aircraft (fig. 47). Otherwise, it may be attached to either side.

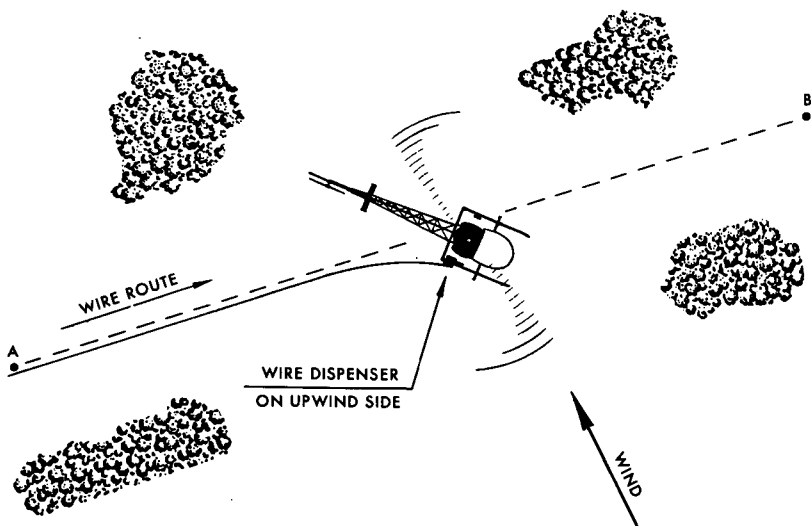


Figure 47. Wire dispenser mounted on rotary wing aircraft.

APPENDIX XIX

HELICOPTER EXTERNAL LOAD OPERATIONS

Section I. INTRODUCTION

1. General

This appendix provides guidance for all units concerned with techniques and procedures utilized in transporting materiel externally by helicopter. It contains information on the responsibilities of agencies concerned, selection and preparation of operational sites, ground crew training, aircrew procedures, equipment, and data, ground control and hookup procedures, and preparation and rigging of loads. Precautions and emergency procedures are included where necessary.

a. Information on load preparation and selection and preparation of operational sites is general in nature and modification of these procedures and techniques may be required to meet specific requirements.

b. Cargo slings employed and techniques discussed in this appendix have proved satisfactory.

2. Equipment

Equipment listed in section VI must be organic to the helicopter company and/or the unit to be transported.

3. Definitions

a. Hook Assembly. An assembly consisting of tension cables, hook, and hook release mechanisms.

b. Cargo Sling. A load suspension device used to confine and/or support the load.

c. Cargo Net. A specific type of cargo sling usually constructed of rope or steel cable netting, with attached rings or eyes spaced along the edges to evenly distribute the weight within the net.

d. Pallet. A flat, rigid platform used with a cargo sling to provide restraint, support, and/or protection to a number of small or fragile items.

e. Loading Area. A specified area in which loading sites and assembly areas are located, and from which the movement of units, equipment, and supplies by aircraft is initiated.

f. Landing site. A designated area within a landing zone where one or more helicopters can land and take off.

g. Pickup Site. A designated point where a helicopter may pick up personnel, equipment, and supplies without landing.

h. Landing Point. Actual spot in a landing site where load is released.

Section II. BASIC RESPONSIBILITIES

4. General

Successful helicopter sling operations require liaison and coordination between all agencies concerned.

5. Using Agency

a. Initial Request. In initiating a request for aerial support, the requesting agency will include in the request—

- (1) Date and time of operation.
- (2) Estimated total weight of material to be transported.
- (3) Estimated weight of heaviest item to be transported.
- (4) Size of most bulky items.
- (5) Location of loading area.
- (6) Location of landing site.

b. Personnel. The using agency will provide personnel to work under the supervision of the helicopter unit to—

- (1) Select and prepare landing site(s).
- (2) Load and/or unload slings at loading areas and landing sites.
- (3) Perform duties of signal and hookup men.
- (4) Assist in recovery of slings and/or equipment.

c. Fire Support Coordination. The force commander will initiate and coordinate requests for fire support through appropriate fire support channels. Coordination of fire support will include all appropriate measures necessary to insure success of the operation; e.g., flak suppression fires.

6. Helicopter Unit

The helicopter unit responsibilities include:

- a.* Providing liaison personnel when required.
- b.* Recommending routes and altitudes to be flown.
- c.* Coordinating with air defense artillery.
- d.* Assigning supervisory personnel to work with using agency.
- e.* Determining training requirements and supervising the training of using agency personnel.
- f.* Determining equipment requirements.

g. Supervising preparation and rigging of cargo if required to the extent the availability of personnel will allow.

h. Assisting in recovering helicopter unit equipment (slings, nets, etc.) upon completion of mission.

Section III. OPERATIONAL SITES

7. General

Proper identification of sites by adequate marking and/or air-ground radio communication is important. Many successful deliveries have been made in totally unprepared areas without trained ground personnel present; however, to insure safe, accurate, and timely delivery of equipment or supplies, the facilities discussed below should be provided when possible.

8. Loading Area

a. *Selection.* The loading area (fig. 48) should be well protected from enemy fire and of sufficient size and accessibility to handle the desired volume of traffic. It is usually located near an airstrip and/or a road. Camouflage of supplies is desirable and should be considered in selecting the site. A relatively level, dust- and sand-free surface is desirable but not essential.

b. *Preparation.* Each helicopter loading point within a loading area should be marked with a color-coded panel or flag or a code letter placed slightly left of the load, facing the pilot's approach.

Note. If more than one landing site is supplied from the same loading area, each loading point should be marked to correspond to the marking of its respective landing site. For example, the load at the yellow panel-marked loading point will go to the yellow panel-marked landing site.

9. Landing Site

Prior selection and/or preparation of landing site may be precluded by enemy fire or urgency of the situation. However, if prior selection and preparation is feasible, the following procedures should be used:

a. *Selection.* The landing site should be located as near the point of contemplated employment as terrain features and enemy action will permit (fig. 48). Approach and takeoff routes are planned to avoid obstructions and areas of severe turbulence. Minimum size of the landing site is determined by type aircraft to be used, atmospheric conditions, and type, size, and weight of cargo.

b. *Preparation.* Trees, brush, large rocks, and rubbish should be removed to prevent possible damage to the helicopter or the load. Area should be relatively level and marked with color panel or

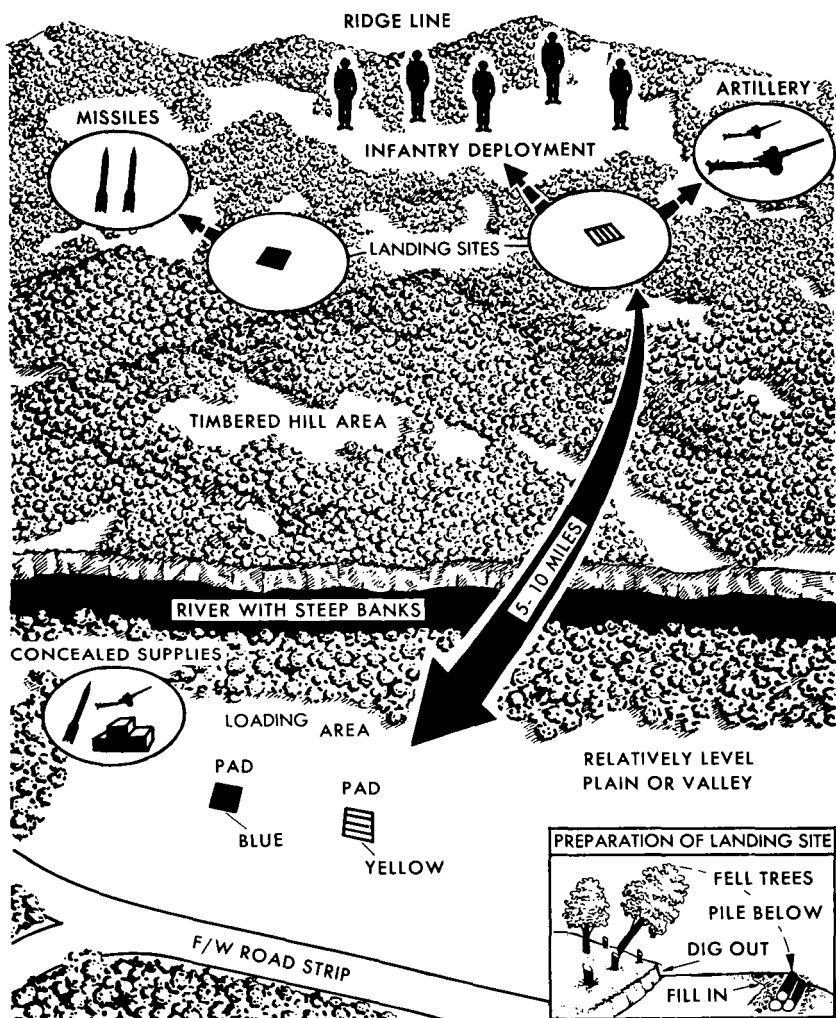


Figure 48. Loading area and landing sites.

according to other prearranged methods. Marking should correspond to respective loading point.

Note. Emergency signals such as "Do Not Land," etc., must be prearranged. When possible, internationally recognized visual danger signals should be employed; i.e., red smoke or panels to form a cross.

Section IV. GROUND CREW TRAINING

10. General

Thorough ground crew training is mandatory to facilitate rapid and efficient hookup and release of loads and to insure reasonable safety of all personnel.

11. Hand Signals

Hand signals used in external load operations are shown in figure 39. If large changes in aircraft positions are desired, hand signal movements are correspondingly large. Smaller and slower hand movements indicate smaller corrections.

12. Requirements

a. Personnel.

- (1) One briefing officer (preferably a pilot).
- (2) Trainees (optimum of three—two hookup men and a signal man).
- (3) Pilot, copilot, and crew chief if required (for each aircraft involved).
- (4) Loading supervisor. (This responsibility can be performed by the briefing officer.)

b. Equipment.

- (1) One aircraft of appropriate type with hook assembly installed.
- (2) Various external loads, properly prepared to illustrate problems involved in both small but heavy loads and light but bulky loads.
- (3) Assorted cargo nets, slings, and other related devices which may be required.
- (4) One set of illuminated wands and sufficient flash or flood lights (if night operations are contemplated).
- (5) Driving goggles or other eye protective devices.
- (6) Dust inhalators and ear plugs as required.

c. Space. Relatively level dust-free area with unrestricted takeoff and approach paths.

d. Time. Fifty-minute period for briefing, followed immediately by a one-hour practice exercise.

13. Ground Crew Procedures for Cargo Loading

Most ground crew personnel have not received previous training in sling load operations. Aircrews are basically trained but will benefit greatly from additional practice. Ground crew procedure for cargo loading is as follows:

a. General. The briefing officer should cover thoroughly all items presented in paragraphs 11, 13, and 14.

b. Signal Man.

- (1) Ascertains that cargo is properly secured and hookup ring is in proper position.
- (2) Assumes a position about 20 to 30 feet beyond and usually upwind of the load with arms upraised and facing the helicopter in such a manner that the pilot can plan an ap-

proach toward him (fig. 49). This distance may be increased when the H-37 is used.

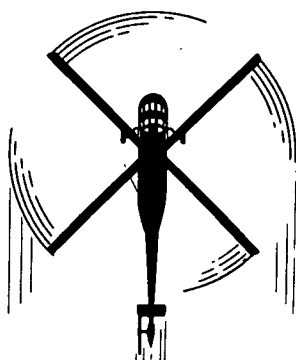
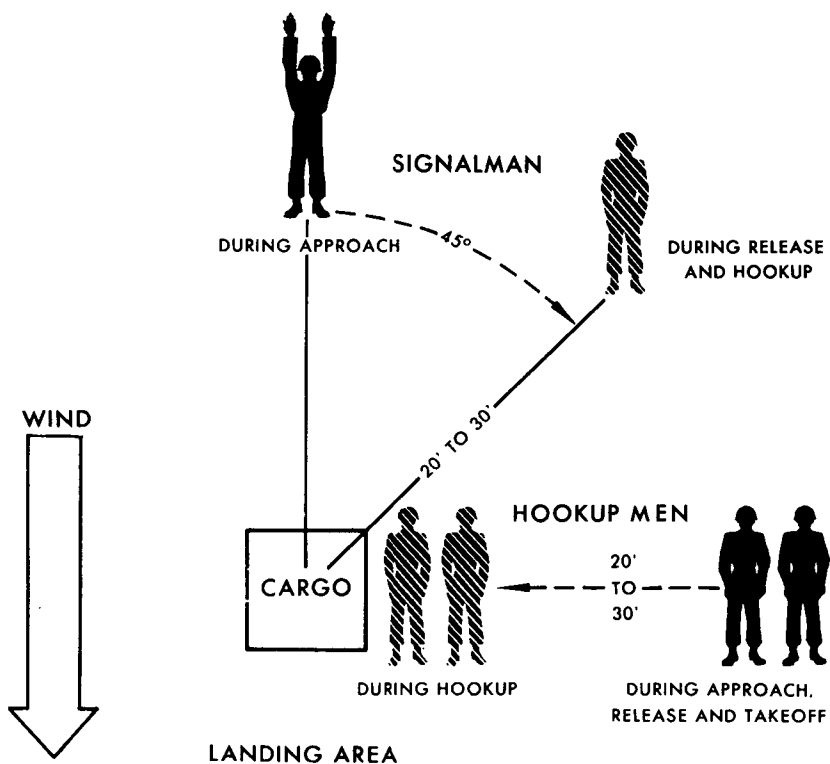
- (3) As the aircraft approaches to a hover, moves to a position about 45 degrees off the pilot's side of the helicopter. Stays within 20 to 30 feet of the load. This position is inside the rotor disc area, sheltered somewhat from the heavy rotor blast encountered under the perimeter of the rotor disc, and permits proper depth perspective of the hook and sling assembly. Keeps in sight of the pilot at all times.
- (4) After helicopter is brought to a hover (slightly above and a foot or two downwind of the load), begins the appropriate signals to assure positioning of the hook squarely over the load and effects a rapid hookup. See also paragraph 22.
- (5) Observes hook and hookup ring at all times. When the hookup personnel have completed their job and moved aside, signals the helicopter gently, maintaining its position directly over the load.
- (6) As the attaching cables become taut, quickly ascertains that all are in order and not fouled or slack and load is clear of ground, then gives clear-to-go signal.
- (7) After waveoff, quickly moves aside to be completely clear of the takeoff path. Is definite and precise in the execution of all hand signals.
- (8) If conditions preclude use of an outside signal man, the alternate hookup and release method (par. 23) may be used.

c. Hookup Personnel.

Note. Under conditions of extra heavy slings and/or awkward hookup conditions, two hookup men may be required; one to handle the hook and the other to handle the hookup ring.

- (1) As the aircraft approaches to a hover, take position just beside the load (fig. 49). (Under certain conditions of bulky or unusual loads, hookup personnel may be positioned atop the load.)
- (2) Take position in such manner that the hook and hookup ring can be seen by the signal man at all times.
- (3) If cargo slings are of metal construction (steel cable or wire), strike the hookup ring against the cargo hook to discharge static electricity and prevent shock when the cargo hook is grasped. If slings are of fabric construction, a grounded wire or cable should be used.

Note. A charge of static electricity is nearly always present on the aircraft and should be discharged before touching the hook with the hand. In any case, the hook should be grasped quickly and firmly and if possible contact maintained until hookup is completed.



EMERGENCY

◀ HELICOPTER MOVES LEFT

EMERGENCY

ALL GROUND PERSONNEL MOVE RIGHT ▶

Figure 49. Position diagram.

- (4) One hookup man holds hookup ring or loop of sling in one hand and secures it in the cargo hook as soon as the signal man has maneuvered the aircraft into position.
- (5) Accomplish job rapidly and accurately.
- (6) After hookup is effected, move aside quickly (fig. 49).

14. Ground Crew Procedures for Cargo Landing

a. Signal Man.

- (1) Assumes a position about 20 to 30 feet upwind of the landing point, facing it and the approaching helicopter. This distance may be increased when the H-37 is used.
- (2) As aircraft approaches, moves to a point about 45° offside (on the pilot's side), keeping the pilot in view.
- (3) Uses standard hand signals to guide the cargo (not the helicopter) to a position a few feet above landing point and directs gentle lowering until load is resting firmly on ground.
- (4) When load is detached from aircraft, waves off pilot in takeoff direction and steps aside out of takeoff path.

b. Hookup Personnel. Hookup personnel are not normally used in the landing operation.

Caution: All ground crew personnel should be thoroughly briefed on emergency release of cargo. Crew members should have a sharp knife and/or cable cutter available to cut slings if all efforts to release cargo fail. In case of emergency during hookup, all ground crew members move to the pilot's right, away from the helicopter.

Section V. AIRCREW PROCEDURES

Note. The pilot is directly responsible for the safety of the aircraft. Decision to go or not go is his. No attempt should be made to carry loads in excess of rated capability for existing conditions.

15. Aircrew Preflight Procedures

a. Ascertain that weather conditions are favorable for the operation.

b. In addition to a regular preflight inspection of the aircraft, check hook assembly for general condition and security of attachment.

c. Actuate all installed types of release mechanism (automatic, electrical, and manual) and the manual closing device to insure proper operation.

d. Brief copilot and crew chief concerning their responsibilities to include emergency actions.

16. Aircrew In-Flight Procedures

a. Insure that hook assembly is released from the "stowed" position before takeoff and is placed back in "stowed" position when the load operation is completed.

Caution: Never drag hook inadvertently on ground or allow it to come into contact with any obstacles; severe damage to the aircraft can result if hook catches on some object.

b. Select takeoff and approach routes to minimize hazards to personnel and property on the ground.

Note. Tandem rotor aircraft usually operate more efficiently under approximately 45° crosswind conditions.

c. Determine that the helicopter is positioned directly over the load before attempting a takeoff.

d. Do not take off until the appropriate signal (figs. 38 and 39) has been received from the signal man.

e. Follow all signals as accurately as possible, making corrections smoothly and precisely.

f. If the hook is jammed and cannot be released by the pilot, and ground personnel are not available, the crew chief or another aircrew member can jump to the ground from hover altitude, move in, and release the load.

Note. Crew members should carry a sharp knife and/or cable cutter to cut slings if all other efforts to release hook fail.

g. In case of forced landing prior to hookup, attempt to move the helicopter to the left (fig. 49), or away from ground crew and load.

h. If forced landing appears imminent while hooked to the load, release load immediately and make an autorotative landing.

Section VI. EQUIPMENT AND DATA

17. General

a. The cargo nets, discussed in paragraph 18, have not yet been approved but it is anticipated they will be available in the near future. TOE's should provide for three nets per helicopter. For larger loads, multiple arrangements of these nets may be used.

b. Materials for assembly of special slings are not presently available as TOE items for all aviation units, but it is anticipated that TOE's will be amended to make these materials available.

18. Cargo Nets

a. *Metal Cargo Net (5,000-Pound Rated Capacity).*

(1) *Description.* The 5,000-pound rated capacity metal cargo drawstring net (fig. 50) is constructed of stranded steel

cables $\frac{5}{32}$ -inch in diameter with built-in corners which afford a box-like effect. Fourteen eyes, $2\frac{3}{8}$ inches in diameter and made from $\frac{3}{8}$ -inch stock, are attached to the edges to distribute the weight evenly within the net.

- (2) *Operation.* This net has a $\frac{1}{4}$ -inch cable through the supporting eyes. Snap hooks, attached to the drawstring and located at three corners of the net, are connected to a hookup ring located at the fourth corner. The hookup

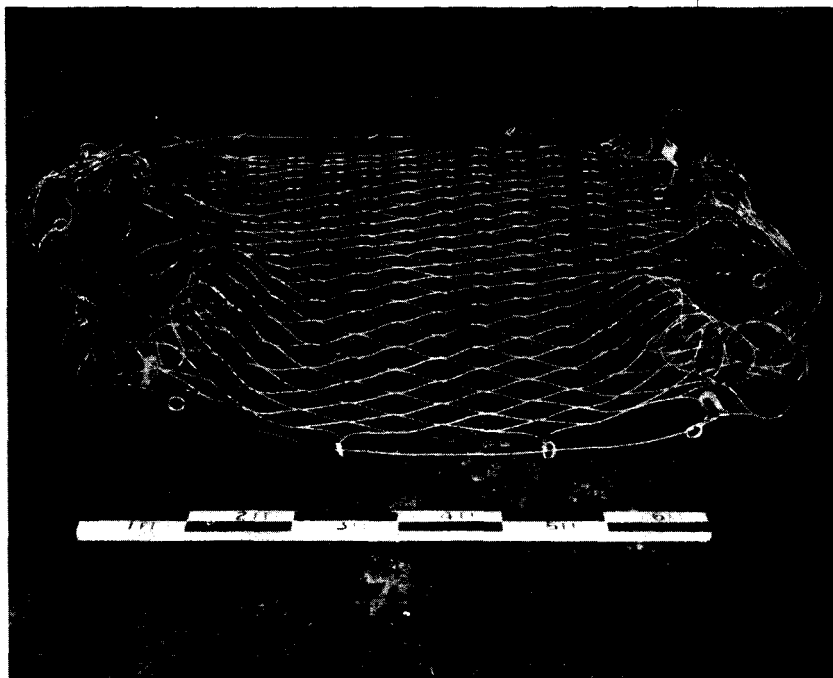
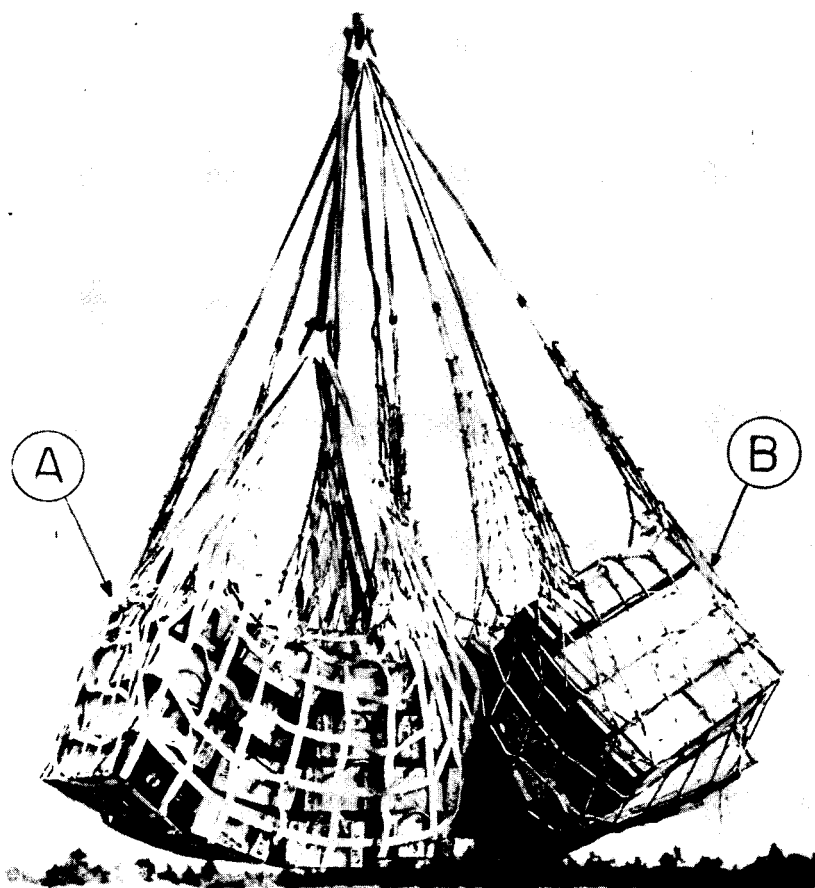


Figure 50. Metal cargo net (5,000-pound rated capacity).

ring, which is attached to the helicopter cargo hook, causes the drawstring to close the net over the load as the helicopter lifts the net.

- (3) *Data.* The net is approximately 60 inches wide, 90 inches long, 48 inches high, and 44 pounds in weight.
- b. *Nylon Cargo Net (3,000-Pound Rated Capacity).*

- (1) *Description.* The 3,000-pound rated capacity nylon cargo net (figs. 51 and 52) may be constructed of either nylon webbing or nylon rope.
- (2) *Operation.* The nylon net may be laid out flat for loading. To load, place load in center of net. Gather net up snugly



A—Left of nylon webbing B—Right of nylon rope

Figure 51. Nylon cargo net (3,000-pound rated capacity).

around load and thread clevis or suspension sling through the loops at each corner.

- (3) *Data.* The net is approximately 12 feet square and weighs 15 pounds.

19. Special Cargo Slings

Special cargo slings varying in length from 2 to 20 feet can be assembled from nylon webbing straps, clevis assemblies, load binders, tie-down straps, and fasteners. Data for sling assembly materials (fig. 53) is given in table XXVII. Typical methods of sling attachment are shown in figure 54.

Table XXVII. Standard Cargo Sling Materials*

Nomenclature	Stock No. (FSN)
Binder, load, eccentric takeup, takeup not limited to a definite length, 3,680 pounds safe working load, w/lever-----	3990-360-0248
Bolt, machine square head, 1-8UNC-2Ax6 with square nut----	5306-208-0476
Sling, cargo, aerial delivery, nylon webbing, 17,480 pound capacity, 192 in. long, 1 1/4 in. wide, AF part No. 48D7304-----	1670-360-0492
Clevis assembly, suspension, small-----	1670-360-0304
Clevis assembly, suspension, large, bolt and nut, AF part No. 49B7460-----	1670-090-5354
Fastener, strap, cargo tiedown, quick fit-----	1670-360-0340
Sling, suspension:	
2-foot length-----	1670-360-0495
5-foot length-----	1670-360-0498
7-foot length-----	1670-360-0500
8-foot length-----	1670-301-5697
9-foot length-----	1670-360-0502
11-foot length-----	1670-360-0504
12-foot length-----	1670-368-7483
20-foot length-----	1670-360-0505
Strap tiedown, length 15 feet-----	1670-360-0540
Tiedown, cargo aircraft, type B-1, 5,000-pound capacity-----	1670-360-0552

*Standard cargo sling materials listed are available through regular supply channels. Some cargo rigging materials, including a few of those shown in this appendix, are not listed. These items should be procured either by means of local purchase or by improvisation from available or procurable materials.



Figure 52. Nylon cargo net (3,000-pound rated capacity) rolled for storage.

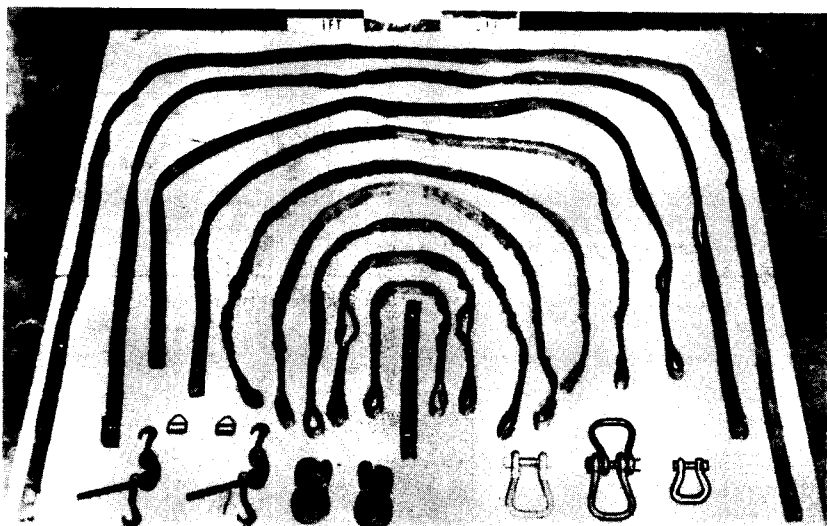
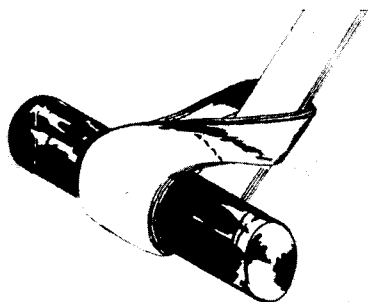
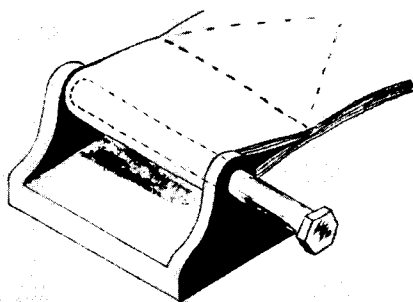


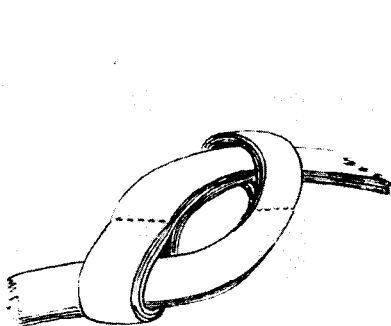
Figure 53. Standard cargo sling materials.



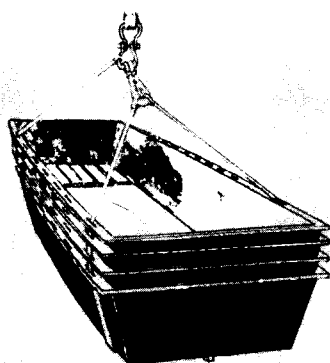
LOOPED SLING



SLING USED WITH BRACKET OR CLEVIS



METHOD OF JOINING SLINGS



EQUIPMENT CRADLED IN SLING

Figure 54. Typical methods of sling attachment.

Section VII. CREW TECHNIQUES

20. General

A summation of procedures utilized in sling load operations can best be presented by simulating a typical flight, starting with an approach to a load and ending with takeoff after the release. With good teamwork, employing firm and positive procedures, a complete hookup will seldom require more than 15 seconds and a release considerably less. *The helicopter referred to in this demonstration has the pilot's seat on the right side.*

21. Hookup Procedures

a. As the aircraft approaches the loading area, the signal man with both arms stretched above his head is seen standing about 20 to 30 feet beyond and usually upwind of the load, facing the approach path (fig. 49). This distance may be increased when the H-37 is used. The hookup personnel inspect the cargo sling and arrange the hookup ring. When satisfied, he moves slightly off to the pilot's side of the load and faces the oncoming aircraft. At this point, all groundcrewmembers put on their eye-protective goggles. As the pilot nears the end of the approach, the signal man moves rapidly to a position about 45° off the pilot's (right-hand) side, but remains approximately 20 to 30 feet from the load, just inside the rotor disk, to avoid the heavy down blast near its perimeter.

b. As the aircraft arrives at a hover a foot or two short of the load, the signal man signals the helicopter slowly forward over the load while one of the hookup men grasps the hookup ring in one hand and the grounding wire in the other and quickly discharges the static electricity by touching the grounding wire to a metal part of the aircraft. He then drops the grounding wire, grasps the hook, and completes the hookup as quickly as possible. The hookup personnel must work quickly and accurately, keeping the hook and ring in sight of the signal man at all times. The signal man must give precise signals and avoid indiscriminate "arm-waving." The pilot must hover with smooth precision and follow the signal man's directions quickly and accurately. When hookup is completed and the hookup man has moved to the right and out of the way, and the helicopter appears to be squarely over the load, the signal is given to increase altitude until the sling becomes taut.

Note. If hookup men lose contact after initial grounding, they must reground the aircraft before contacting it again.

c. The pilot must "feel" his way up with the load. As the tension of the load is felt, gently apply pitch and determine that the aircraft is directly over the load. If the nose dips, the helicopter is too far

forward and must be moved back slightly. If a tilt to the right, the helicopter is too far to the right and must be moved left, etc. When pilot has received the "up" signal from the signal man and with helicopter directly over the load, he smoothly increases pitch and power to rise vertically a few feet, being very particular to maintain proper rpm and observe amount of power applied. At this time the signal man will give the takeoff signal and move quickly off to the right and out of the takeoff path. It is best for the pilot to move slowly into forward flight without actually stopping at a hover if sufficient reserve power is available to attain translational lift for a climb. If doubtful about a successful takeoff, hover momentarily, noting actual manifold pressure required. If it is then determined that a takeoff can be made, lower load to the ground and start a new takeoff. If not, disconnect the load and have some of it removed by the ground crew or defuel the aircraft sufficiently to permit safe lifting of the load.

d. The best takeoff technique under most circumstances is a slow but positive addition of pitch and power until the load is well clear of the ground. Then follow with a very gentle acceleration into translational flight without actually pausing at a hover.

Note. A distinct pause at a hover requires additional power to overcome inertia when beginning acceleration into forward flight. An attempt to move rapidly into translation requires excessive power and places the pilot in an awkward nose-low attitude in case of emergency. It also causes undesirable pendulum actions of the load.

e. Use maximum allowable power only during early portions of the takeoff or until effective translational lift is obtained. All control movements must be small and smooth to avoid undesirable oscillations of the load and to keep power requirements to a minimum.

f. Controls must be coordinated to prevent undesirable load oscillations.

g. It is usually necessary to fly at a slightly reduced airspeed, especially if the load is bulky or has a shape which gives undesirable aerodynamic properties.

22. Release Procedures

a. Improvised marking of the actual touchdown spot will aid the pilot in making an accurate approach. Direction of approach may be determined by lining up with the signal man and the landing point.

b. The pilot may often be required to release a load in an area where no ground crew is available; however, it is most desirable to use a signal man during load release if available. The signal man positioned with arms upraised beyond the landing site, facing the approaching aircraft, indicates to the approaching pilot that the

approach glide path appears good; continue approach. This does not, however, relieve the pilot of his responsibility for conduct of the approach and subsequent landing or unloading. The signal man must maintain line-of-sight contact with the pilot at all times by moving quickly to his position about 45° offside (fig. 49) during the final portion of the approach.

c. A "normal" approach is made under most conditions. Since the load is several feet below the landing gear, proper clearance must be allowed. Arrive at a hover with the load a few feet above the ground. The signal man, if present, will direct the release procedure. Otherwise, lower the load slowly until ground contact is made.

d. The release signal will be given only after the load is firmly on the ground. This does not indicate, however, that the load is detached. The signal man must be sure that the cargo sling is released COMPLETELY from the aircraft before giving the waveoff. If the load does not release, the signal man should be prepared to give the HOLD signal and move in and release the load manually.

e. Upon receiving takeoff signal, the pilot should bring aircraft to a high hover and then move out. This will insure that load is detached and will eliminate danger of the aircraft hook snagging.

23. Alternate Hookup and Release Method

Depending on the tactical situation, availability of personnel, or pilot preference, it may be more advantageous to utilize the crew chief as signal man from inside the aircraft. In this event, the following method will be used:

a. Position crew chief face down on floor of cargo compartment, with head extended far enough out the door to see the cargo hook and load provided a hatch is not provided in the floor for this purpose.

b. Securely fasten a harness or rope to the crew chief for his safety.

c. Establish clear interphone communication between pilot and crew chief.

d. Insure complete understanding of spoken directions by thorough briefing and close teamwork.

e. Hover helicopter above and slightly downwind of load. The crew chief then verbally directs aircraft to proper position for hookup.

f. Upon ascertaining that the hookup man has satisfactorily accomplished his job and has moved out of the way, crew chief determines that the helicopter is directly over load and advises pilot to take off.

g. During hookup and takeoff, crew chief watches the load to insure that it is riding satisfactorily.

h. Upon arrival at landing point and during final stages of approach, crew chief verbally advises pilot in avoiding obstructions or striking the load on the ground, and finally in positioning load on spot for release.

i. When load is resting securely on the ground, crew chief advises pilot to release load.

Note. Before giving takeoff signal, the crew chief must be certain that the load is completely disconnected from the aircraft.

Section VIII. PREPARATION AND RIGGING OF LOADS

24. General

a. Procedures for the following selected loads have proved satisfactory by actual tests. Procedures given in paragraph 25, below, are for cargo nets. The remaining loads are prepared with cargo slings assembled from materials discussed in paragraph 19 and shown in table XXVII. Additional loads may be prepared by using these techniques as a guide.

b. Maximum loads to be carried will be determined by the helicopter unit. Loads should be prepared accordingly.

25. Miscellaneous Supplies

Miscellaneous small items of supply which have reasonable resistance to crushing action, such as rations, ammunition, certain medical supplies, clothing, and fuel in 5-gallon cans or 50-gallon drums,

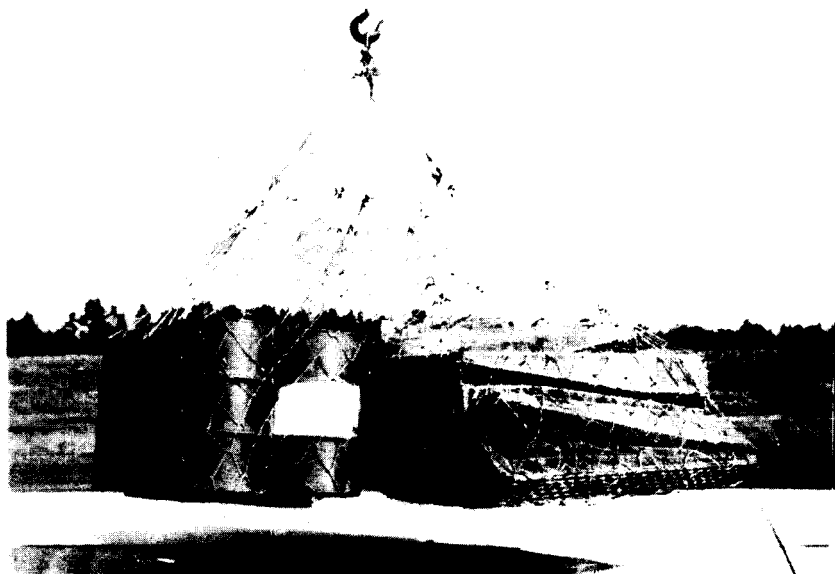


Figure 55. Metal cargo nets, 5,000-pound capacity, multiple arrangement, typical.

are especially suited for transport in cargo nets (figs. 51 and 55) and are prepared as follows:

a. Spread the net in such a way that items may be arranged around the center to minimize shifting of the load during lifting. Overloading will cause spillage over the top of nondrawstring type net and severe crushing action by the drawstring type, and should be avoided.

b. If it is determined that excessive shifting and damage to the load may occur during lifting, pallets of appropriate size may be constructed from available materials such as crating boards, plywood, or poles and placed in the net below and/or above the load.

c. Close the net over the load. To avoid fouling during pickup, arrange all parts of the net in an orderly manner.

26. Conex Container (Army Transporter)

Use figure 56 as a guide and proceed as follows:

a. Preparation. Fragile internal cargo must be restrained with shoring or by other suitable method.

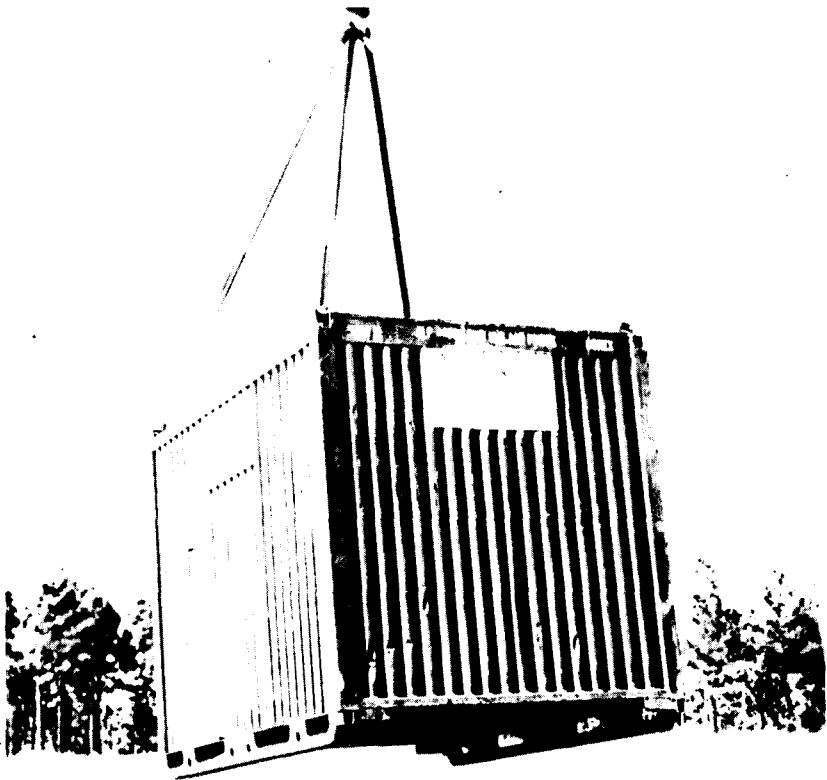


Figure 56. Conex container (Army transporter) (weight, empty—1,600 pounds).

b. Rigging.

- (1) Use small clevises and attach one 9-foot sling to each corner of container.
- (2) Connect four slings at apex by means of large dual clevis.

Caution: Ground hookup crew must stand on top of container to effect hookup. Positive pilot control is required to insure hookup crew clearance of load before takeoff.

27. Sealdbin 70, Container

Use figure 57 as a guide and proceed as follows:

a. Use small suspension clevis assemblies and attach one 4-foot sling to each of two clevises provided on dispensing end of container.

b. Attach large clevis to open end of slings.

Caution: The container must lie flat on the ground prior to takeoff. Hookup may be effected either from the ground or from the hover. Whichever is used, the container must be raised cautiously to a vertical position before the load will lift. On landing, the hook may be released with the container vertical on the ground. It will fall over on release, but will not result in any damage.

28. Containers, Gasoline, 55-Gallon

Use figure 58 as a guide and proceed as follows:

a. Rigging.

- (1) Lay out two C-2 cargo tiedown chains parallel to each other and two feet apart.
- (2) Place drum (A) across both chains.
- (3) Run chains through loops (B) of four 7-foot slings.
- (4) Place other drums as indicated with 7-foot slings running upward around drum (A) and between two top drums.
- (5) Draw C-2 tiedown chains tight around all five drums by use of C-2 tensioning device. Chains are outboard of all four web slings.
- (6) Attach all four slings to dual clevis.

b. Other Methods. This is an alternate method of transporting this type container. Other suitable methods are by use of pallets and/or cargo nets.

Note. Rigging of the load requires two C-2 tiedown chains and two C-2 tensioning devices which are not included in table XXVII.

29. Shelter S-141

Use figure 59 as a guide and proceed as follows:

a. Preparation.

- (1) Lash equipment and loose cargo securely inside shelter.



Figure 57. Sealdbin 70, container (weight—3,140 pounds w/500 gallons of gasoline).

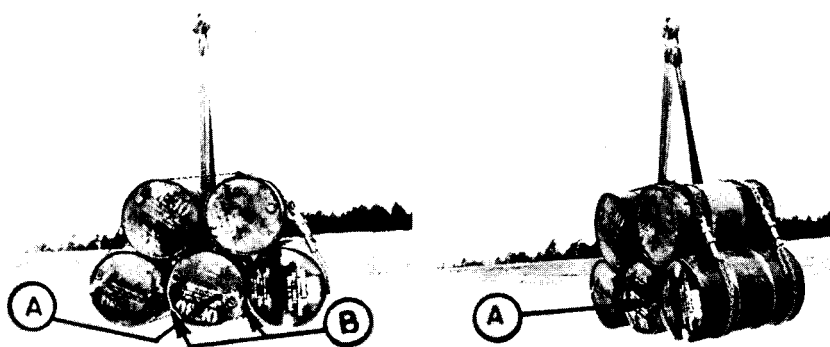


Figure 58. Containers, gasoline, 55-gallon (weight—1,950 pounds).

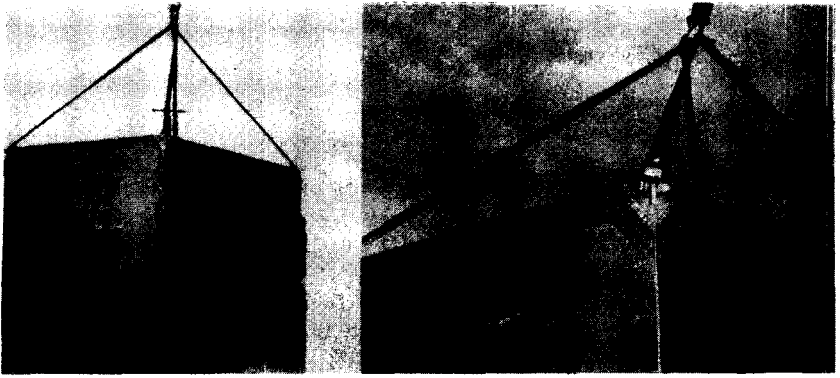


Figure 59. Shelter S-141 (weight, empty, aluminum and plywood—1,290 pounds; plastic—1,170 pounds).

- (2) Lash 4- x 5-foot sheet of plywood to center top of shelter to prevent damage by falling clevis.

b. Rigging.

- (1) Use small clevises and attach 7-foot slings to lifting eyes as indicated.
- (2) Connect slings at apex by means of large dual clevis.

Caution: Ground hookup crew must stand on top of shelter to effect hookup. Positive pilot control is required to insure crew clearance of load before takeoff.

30. Howitzer, 105-MM., Type Load #1 of Two Type Loads

Use figure 60 as a guide and proceed as follows:

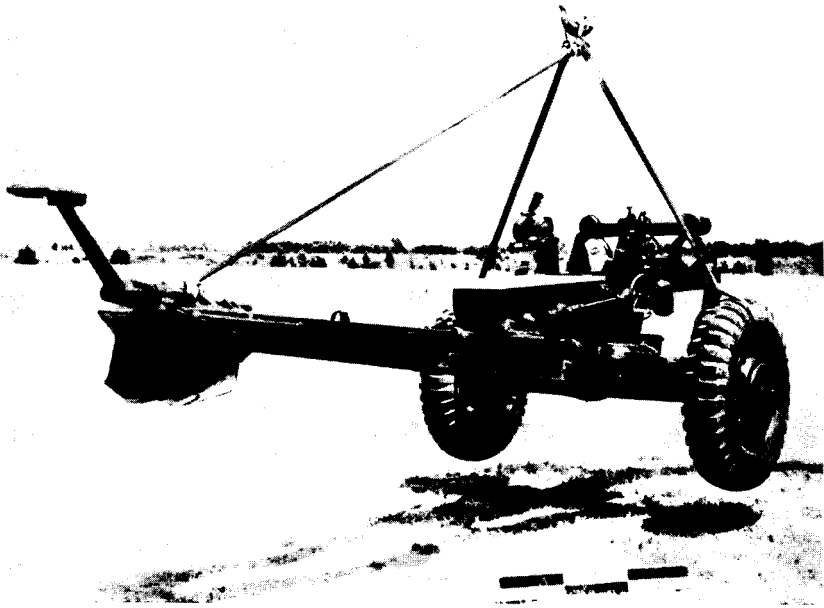
a. Preparation.

- (1) Remove tube from recoil mechanism.
- (2) Remove all shields.
- (3) Place howitzer in travel position.
- (4) Lash plywood, combat packs, or other padding to protect slide and sight mount against damage from falling clevis.
- (5) Set handbrakes.

b. Rigging.

- (1) Loop 8-foot sling around each wheel rim and tire.
- (2) Loop 12-foot sling around lunette arm.
- (3) Secure three sling ends at apex with a large clevis.

Caution: Takeoff and landing must be vertical to prevent spades digging into ground.



Type load No. 1 of two type loads (weight—3,300 pounds w/o shields).

Figure 60. Howitzer, 105-mm.

31. Howitzer, 105-MM., Type Load #2 of Two Type Loads (w/Crew)

Use figure 61 as a guide and proceed as follows:

a. Preparation.

- (1) Remove breech block and place in section chest.
- (2) Remove tube from howitzer.

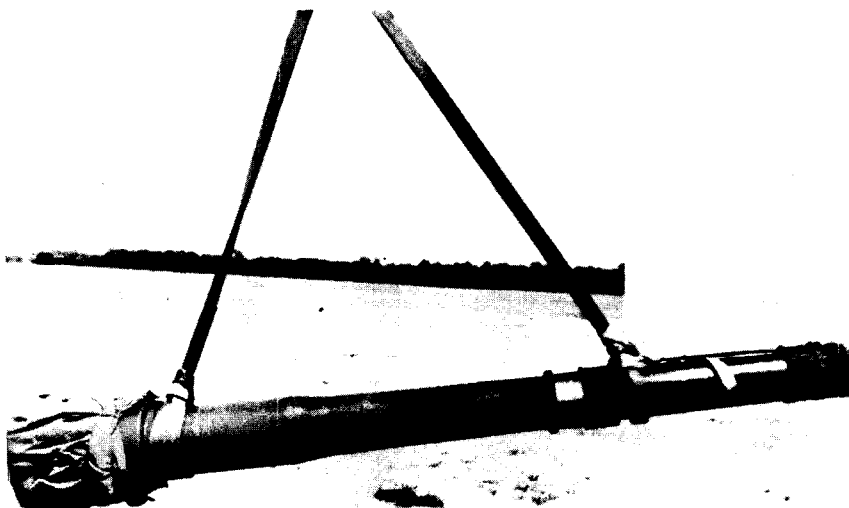
Note. Removal of tube will require use of two timbers 2 inches by 4 inches by 8 feet, or similar type lifting bars.

- (3) Place locking ring in section chest.

b. Rigging.

- (1) Loop two 7-foot slings around tube at points indicated.
- (2) Run 15-foot tiedown strap through tube and tie ends to sling loops to prevent loops sliding together when tension is applied.
- (3) Lash muzzle cover in place.
- (4) Lash canvas cover around breech.

Warning: Canvas covers and locking nut serve to keep sand and dirt out of respective parts. If dirt penetrates these covers, reassembly may be difficult and firing dangerous.



Type load No. 2 of two type loads (weight—approximately 3,400 pounds with 10-man crew).

Figure 61. Howitzer, 105-mm.

- (5) Join 7-foot slings at apex by means of large clevis.
- (6) Move helicopter into position beside load.
- (7) Attach large clevis to cargo hook.

Note. Load crew before takeoff. If tube and howitzer are landed immediately adjacent to one another, a moderately trained crew can be ready to fire in less than 5 minutes after touchdown.

32. Howitzer, 75-MM.

Use figure 62 as a guide and proceed as follows:

a. Preparation. Place howitzer in firing position with trails closed.

b. Rigging.

- (1) Loop one 5-foot sling around axle on each side of carriage.
- (2) Loop one 9-foot sling around pulling bar near trails.
- (3) Secure all three sling ends at apex by means of large clevis or 2-foot sling.

Caution: Takeoff and landing must be vertical to prevent spades digging into ground.

33. Gun, 76-MM., Antitank

Use figure 63 as a guide and proceed as follows:

a. Preparation. Release tube from travel clamp and raise free of trails.

b. Rigging.

- (1) Center one 11-foot sling under tube and tack it in place with tape.
- (2) Loop one 12-foot sling around each trail.

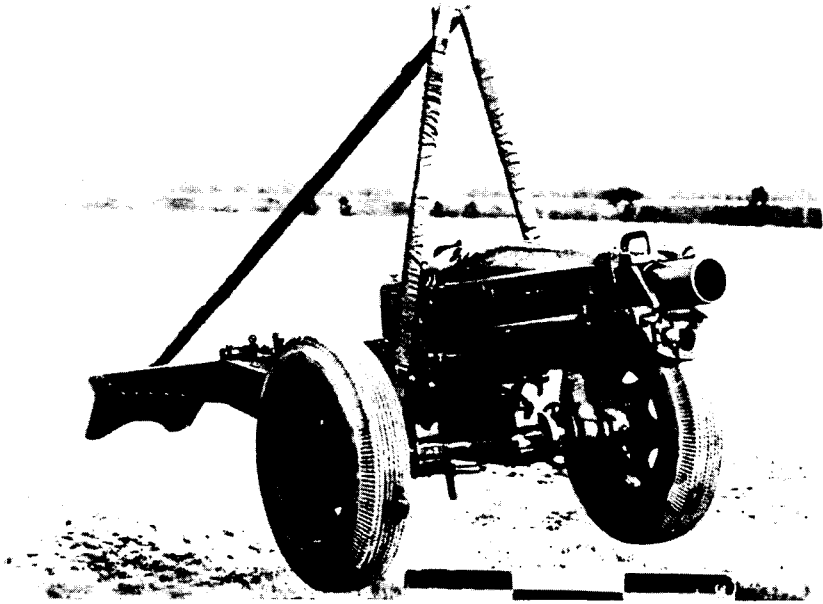


Figure 62. Howitzer, 75-mm. (weight—1,440 pounds).

- (3) Secure four sling ends with large clevis.

Caution: Takeoff and landing must be vertical to prevent spades digging into ground. Muzzle end of tube must ride free of trails since distortion of the tube may be experienced if force is exerted at that end.

34. 4.2 Mortar With Crew

Use figure 64 as a guide and proceed as follows:

a. Preparation.

- (1) Place weapon in center traverse, low range.
- (2) Lash combat pack or other padding to protect sight mount.

b. Rigging.

- (1) Run ends of one 8-foot sling through opposite hand grips on rotator and center sling.
- (2) Loop one 5-foot sling around each side of bridge.
- (3) Run one 5-foot sling through all four sling ends and loop it through itself.
- (4) Use large clevis or 2-foot sling at top of 5-foot sling.
- (5) Secure baseplate to rotator by means of tiedown strap.
- (6) Move helicopter into position beside mortar.
- (7) Attach clevis or 2-foot sling to cargo hook.
- (8) Have crew board helicopter.

Note. Mortar sight, cleaning staff, and aiming stakes are carried by crew members. Hookup is effected with helicopter on the ground beside the load. The load is released from a hover.

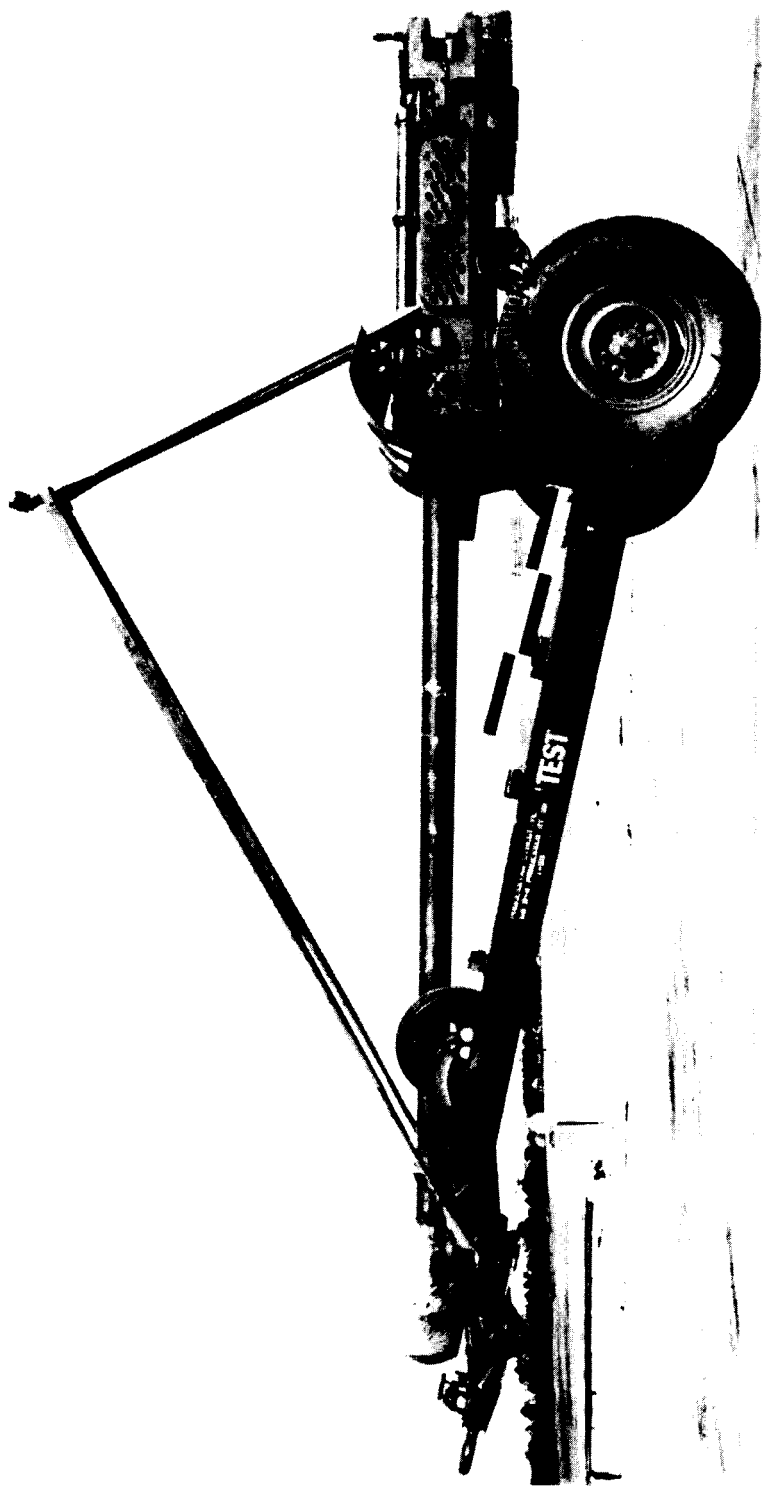
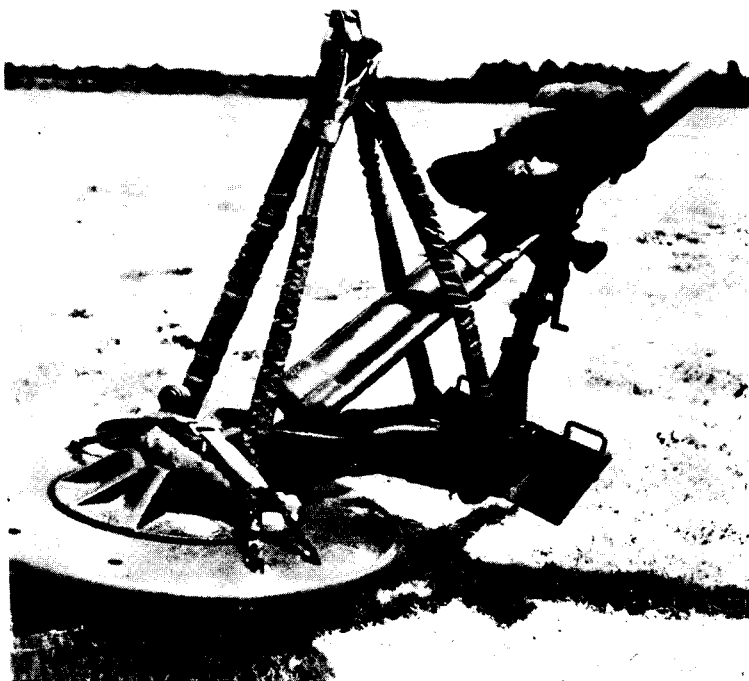


Figure 63. Gun, 76-mm., antitank (weight—3,570 pounds; weight can be reduced 100 pounds by removing shield and trail wheel).



*Figure 64. 4.2 mortar with crew (crew not pictured)
(weight—approximately 2,600 pounds).*

35. 81-MM. Mortar w/Ammunition and Crew

Use figure 65 as a guide and proceed as follows:

a. Preparation.

- (1) Lay cargo net flat on ground.
- (2) Stack ammunition boxes in center of net.
- (3) Lash mortar components to ammunition boxes as indicated above.

b. Rigging.

- (1) Draw net snugly around load.
- (2) Lace 8-foot sling through mesh around net at top of load and loop through itself to act as drawstring on net.
- (3) Secure large clevis to loose end of 8-foot sling.
- (4) Move helicopter into position beside load.
- (5) Attach large clevis to cargo hook.
- (6) Crew members board helicopter.
- (7) Mortar sight, cleaning staff, and aiming stakes are carried by crew members.

Note. Hookup is effected before takeoff. For landing, the external load is released before landing helicopter.

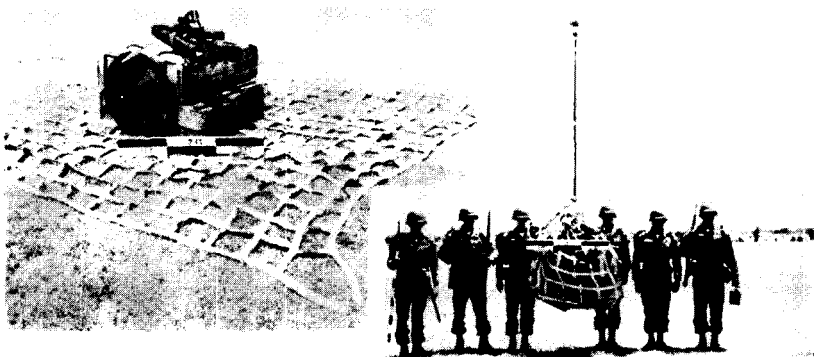


Figure 65. 81-mm. mortar w/ammunition and crew (weight—approximately 2,100 pounds).

36. Carrier, Light Weapons, Infantry (Mechanical Mule)

Use figure 66 as a guide and proceed as follows:

a. Preparation.

- (1) Fold and secure seat.
- (2) Set handbrake.
- (3) Place gearshift in neutral position.

b. Rigging.

- (1) Attach 8-foot sling to each wheel lug by means of small clevis.
- (2) Join four slings at apex by means of dual clevis or 2-foot sling.

Caution: Carrier may be damaged if landed heavily. Landing should be made vertically and as gently as possible.

37. Truck, ¼-Ton, 4x4, M38A1

Use figure 67 as a guide and proceed as follows:

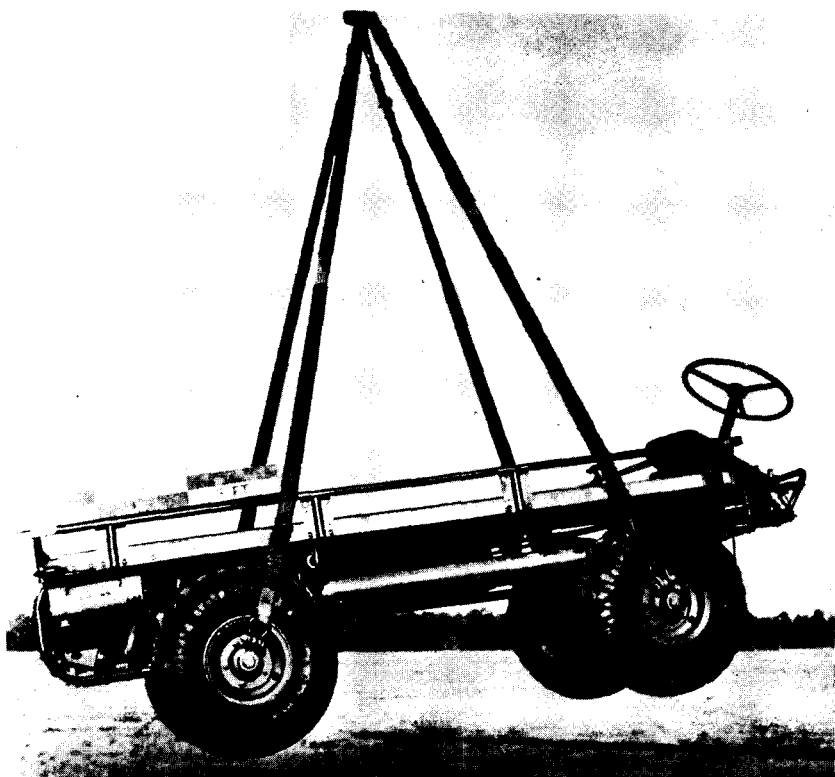
a. Preparation.

- (1) Remove shackles from lifting brackets.
- (2) Fold back of rear seat to down position.
- (3) Lower windshield and retract rear view mirror.
- (4) Secure plywood cover (not shown) over windshield.
- (5) Place gearshift in neutral position.
- (6) Set emergency brake.

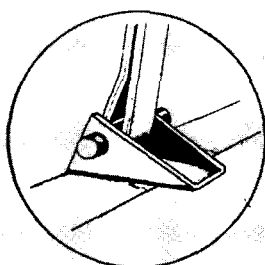
b. Rigging.

Caution: Carefully inspect all lifting brackets before rigging since loose, worn, or damaged brackets may fail in flight.

- (1) Secure 11-foot sling to each rear lifting bracket by running bracket bolt through loop end of webbing (A).
- (2) Secure 9-foot sling to each front lifting bracket in the same manner.



*Figure 66. Carrier, light weapons, infantry (mechanical mule)
(weight—800 pounds).*



DETAIL A

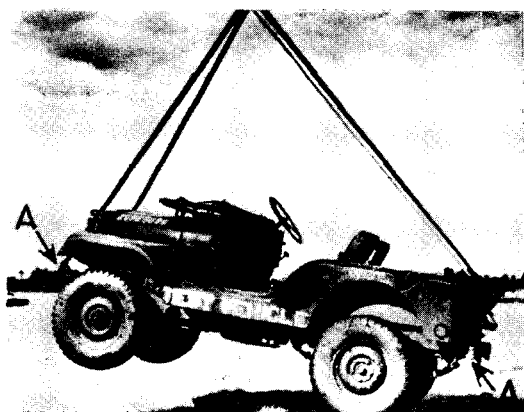


Figure 67. Truck, 1/4-ton, 4 x 4, M38A1 (weight—2,700 pounds).

- (3) Safety all bracket bolts with cotter pins.
- (4) Attach all four slings at apex by means of a dual clevis.
Caution: Ground hookup crew must be alert to prevent sling fouling on steering wheel or fenders when slack is removed during pickup.

38. Truck, ¼-Ton, 4x4, M38A1, w/Coupled ¼-Ton Trailer

Use figure 68 as a guide and proceed as follows:

a. Preparation.

- (1) Couple truck and trailer in normal manner.
- (2) Weight shown is empty weight. One-half of any trailer load should be moved to truck.
- (3) Lash all loose items in truck and trailer.
- (4) Lash trailer tarp securely to prevent flapping in flight.
- (5) Remove clevises from truck lifting brackets.
- (6) Inspect brackets.
- (7) Lower windshield and retract rear view mirror.
- (8) Place gearshift in neutral position.
- (9) Set emergency brake.
- (10) Secure plywood cover over windshield.

b. Rigging.

- (1) Using type C-2 tiedown chains and tensioning devices, connect each rear spring shackle on truck to axle or trailer. Tighten clevis to leave one inch sag in the middle.

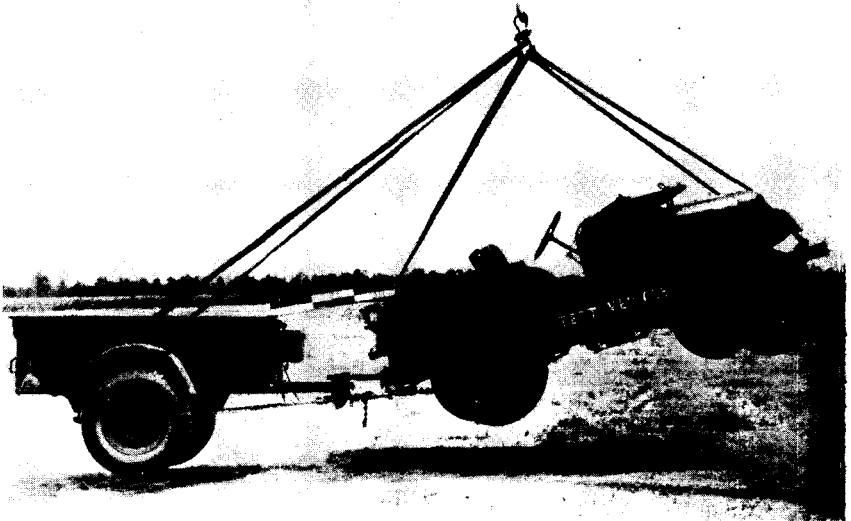


Figure 68. Truck, ¼-ton, 4 x 4, M38A1, w/coupled ¼-ton trailer (weight—3,150 pounds).

- (2) Attach 11-foot sling to each of four lifting brackets on truck.

Caution: Worn or damaged lifting brackets may fail in flight.

- (3) Connect two 192-inch aerial delivery cargo slings by running slings through their own loop ends to form one sling 32 feet long.
- (4) Center knot of long sling under the body of trailer aft of the fenders and secure sling on trailer by length of cord between points.
- (5) Attach all six loose ends of sling at apex by means of a dual clevis.
- (6) Bundle slings together at several points and tack with masking tape (not shown) to prevent blowing during hookup.

Caution: Takeoff must be vertical until trailer wheels are approximately 4 feet off the ground. Ground hookup crew must be alert to prevent slings fouling on steering wheel or other protuberances during pickup.

39. Truck, $\frac{1}{4}$ -Ton, 4x4, w/Mounted 106-MM. Recoilless Rifle

Use figure 69 as a guide and proceed as follows:

a. Preparation.

- (1) Lower windshield and retract rear view mirror.

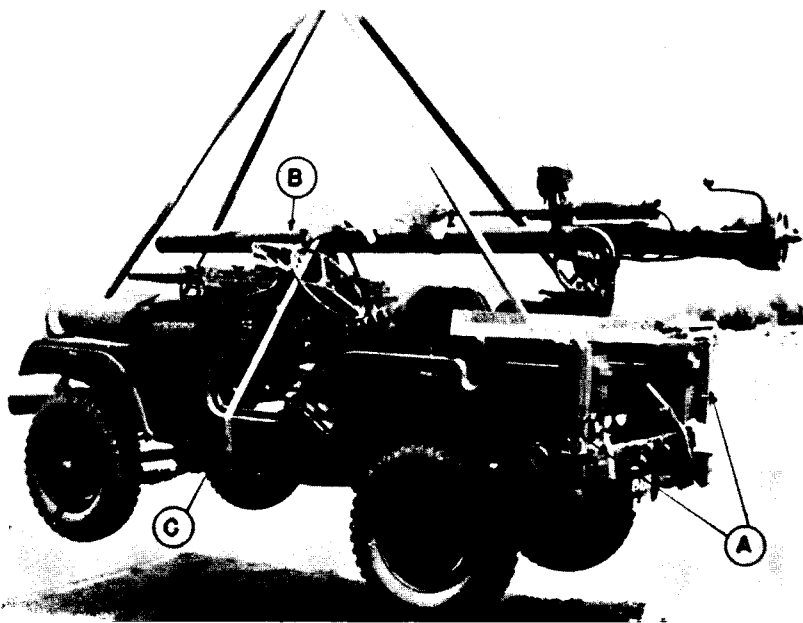


Figure 69. Truck, $\frac{1}{4}$ -ton, 4 x 4, w/mounted 106-mm. recoilless rifle (weight—3,300 pounds).

- (2) Secure plywood cover over windshield.
- (3) Place gearshift in neutral position.
- (4) Set emergency brake.
- (5) Secure 106-mm. recoilless rifle and ammunition in truck in the normal manner.
- (6) Safety lock levers with cord as indicated (A).
- (7) Release tube from travel clamp and center over hood. Lower onto combat pack or other padding as indicated (B). Secure with strap as indicated (C).
- (8) Remove shackles from lifting brackets.

b. Rigging.

- (1) Secure 11-foot suspension sling to each rear lifting bracket by running bracket bolt through loop end of webbing.
- (2) Secure 9-foot suspension sling to each front lifting bracket in the same manner.
- (3) Safety all bracket bolts with cotter pins.
- (4) Attach all four webs at apex by means of a dual clevis.

Caution: Carefully inspect all lifting brackets before rigging as worn or damaged brackets may fail in flight. Ground hookup crew must be alert to prevent sling fouling on steering wheel or fenders when slack is tightened during pickup.

40. Trailer, ¾-Ton, Cargo, w/ or w/o Cargo

Use figure 70 as a guide and proceed as follows:

Caution: This item has poor but acceptable flight characteristics. Cargo weight will improve flight characteristics.

a. Preparation.

- (1) Lash cargo (if any) securely in trailer, keeping the center of gravity forward of the axle.
- (2) Lower tailgate and secure as indicated.
- (3) Secure lunette stand in "up" position.
- (4) Set handbrake.
- (5) If trailer tarp is used, it must be tightly lashed to prevent possible severe instability during flight.

b. Rigging.

- (1) Loop 8-foot sling around each main frame member at extreme aft end. Run loose end of each sling up through gap between tailgate and body.
- (2) Loop 9-foot sling around lunette arm.
- (3) Attach three sling ends at apex by use of large clevis or 2-foot sling.

Caution: Avoid dragging during takeoff and landing as lunette may dig into ground.

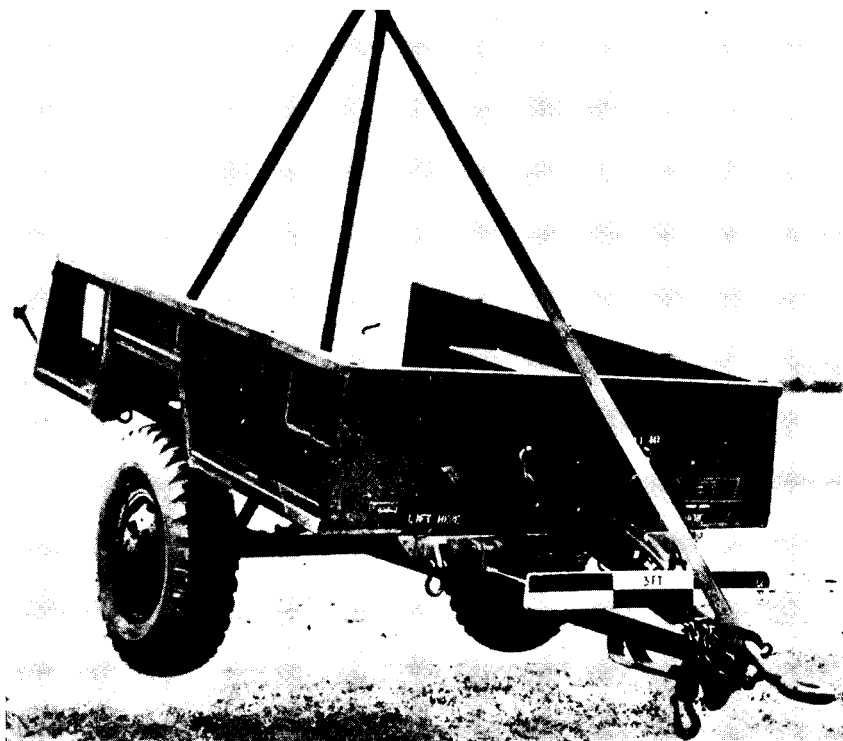


Figure 70. Trailer, $\frac{1}{4}$ -ton, cargo, w/ or w/o cargo (weight, empty—1,420 pounds).

41. Trailer, $\frac{1}{4}$ -Ton, With Cargo (Welding Equipment Set Number 1)

Use figure 71 as a guide and proceed as follows:

a. Preparation.

- (1) Secure cargo in trailer keeping center of gravity forward of the axle. Lash securely.
- (2) Set handbrake.
- (3) Secure lunette stand in "up" position.
- (4) If trailer tarp is used, it must be tightly lashed to prevent possible severe instability during flight.

b. Rigging.

- (1) Loop 7-foot sling around lunette arm.
- (2) Center 16-foot sling under bed of trailer aft of the fenders to form a cradle. Secure in place by tying with cord between points (A).
- (3) Use 2-foot sling or a clevis to connect the three slings at apex.

Caution: Caution must be exercised when trailer is transported without cargo as the weight is not sufficient to provide stability. Stability is increased as total weight is increased.

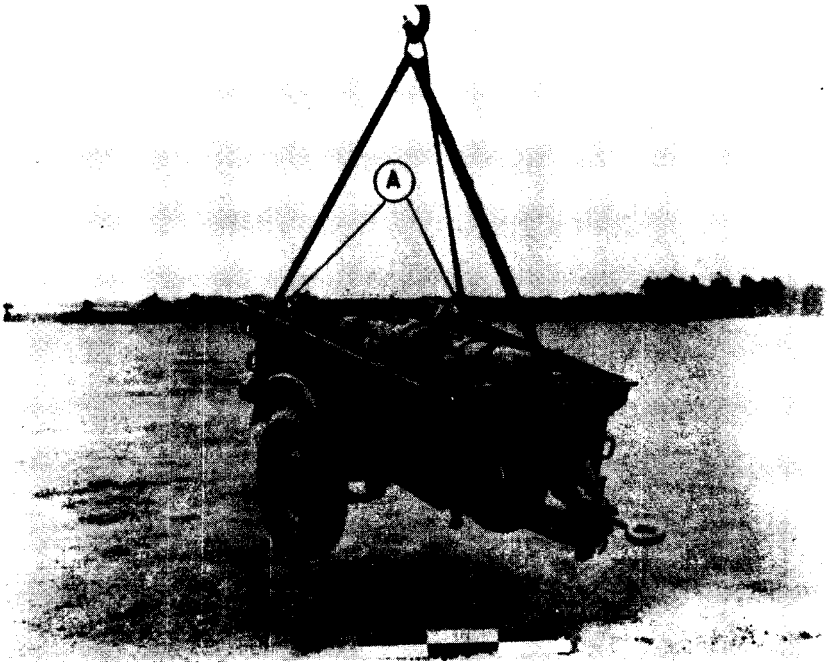


Figure 71. Trailer, 1/4-ton, w/cargo (welding equipment set number 1) (weight—1,100 pounds).

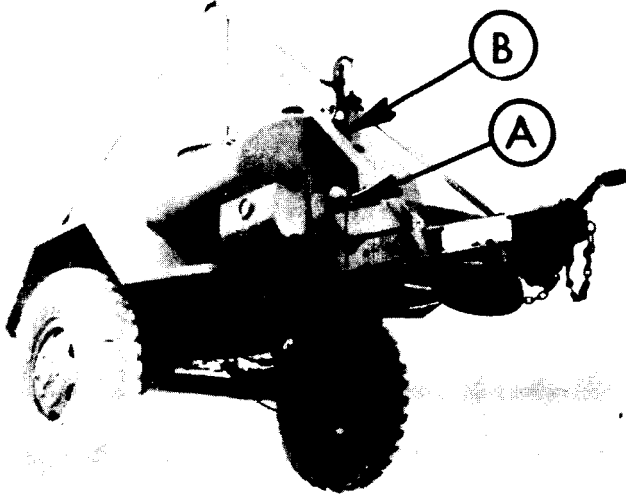


Figure 72. Trailer, 1 1/2-ton, water, 2W (weight, empty—2,400 pounds).

42. Trailer, 1 ½-Ton, Water, 2W

Use figure 72 as a guide and proceed as follows:

a. Preparation.

- (1) Secure lunette stand in "up" position.
- (2) Set handbrake.
- (3) Lash water hose (A) to structural members forward of water tank.

b. Rigging.

- (1) Loop 9-foot slings through forward hand grips and around main structural members forward of water hose. Pad sharp corners of frame under slings.
- (2) Loop 9-foot slings around frame aft of water tank.
- (3) Secure four slings at apex with large clevis or 2-foot sling.
- (4) Tack slings to body with masking tape (not shown) to prevent fouling on water pump (B).

Caution: Do not drag on takeoff and landing as lunette may dig into ground.

43. Trailer, 1 ½-Ton, Cargo, With Sideboards and Cargo

Use figure 73 as a guide and proceed as follows:

a. Preparation.

- (1) Remove tarp, rear gate, and bows. Lash securely in trailer.
- (2) Load and lash cargo keeping center of gravity forward of axle.
- (3) Lower tailgate and secure in horizontal position.
- (4) Secure lunette stand in "up" position.
- (5) Set handbrake.

b. Rigging.

- (1) Loop 9-foot sling around each main frame member at extreme aft end. Run loose end of sling up through gap between tailgate and body.
- (2) Loop 11-foot sling through and around lunette.
- (3) Attach three sling ends at apex by use of large clevis.

Caution: Avoid dragging in takeoff as lunette may dig into ground.

44. Trailer, 1 ½-Ton, With Generator PE 95

Use figure 74 as a guide and proceed as follows:

a. Preparation.

- (1) Lash cargo (if any) securely in trailer, keeping center of gravity forward of the axle.
- (2) Lower tailgate and secure as indicated.

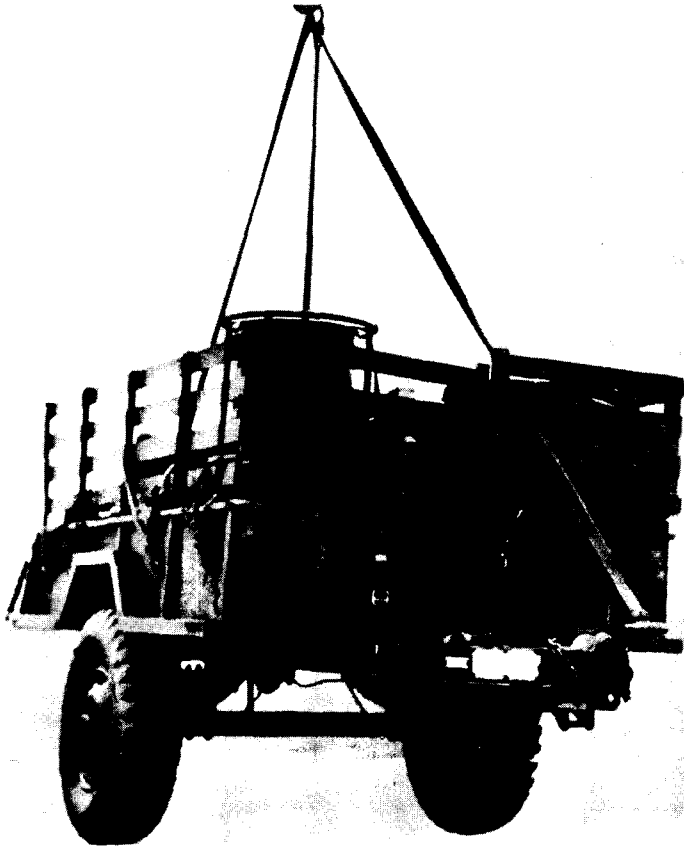


Figure 73. Trailer, 1½-ton, cargo w/sideboards and cargo (weight, empty—1,500 pounds).

- (3) Secure lunette stand in “up” position.
- (4) Set handbrake.
- (5) If trailer tarp is used, it must be tightly lashed to prevent possible severe instability during flight.

b. Rigging.

- (1) Loop 8-foot sling around each main frame member at extreme aft end. Run loose end of each sling up through gap between tailgate and body.
- (2) Loop 9-foot sling around lunette arm.
- (3) Attach three sling ends at apex by use of large clevis or 2-foot sling.

Caution: This item has poor but acceptable flight characteristics. Cargo weight will improve flight characteristics. Avoid dragging during takeoff as lunette may dig into ground.

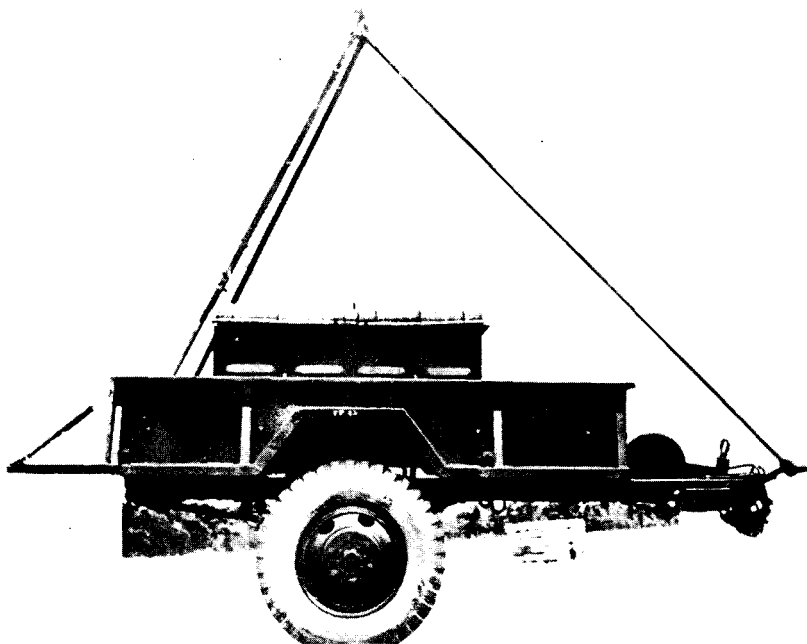


Figure 74. Trailer, 1½-ton, w/generator PE 95 (weight—3,000 pounds).

45. Trailer, 2½-Ton, Pole, 2W

Use figure 75 as a guide and proceed as follows:

a. Preparation.

- (1) Adjust tongue to shortest position.
- (2) Secure lunette stand in "up" position.

b. Rigging.

- (1) Loop one 8-foot sling around each main frame member aft of the rear spring shackle.
- (2) Loop one 12-foot sling around tongue and through lifting handles.
- (3) Secure three slings with large clevis at apex.

Caution: Avoid dragging during takeoff and landing as lunette may dig into ground.

46. Tank Tracks

Use figure 76 as a guide and proceed as follows:

a. Preparation.

- (1) Lay track flat on ground and roll in the manner indicated.
- (2) Tie outside end in place.

b. Rigging.

- (1) Cradle upper section of each track in 11-foot sling. Sling should fit into recesses between track connectors.

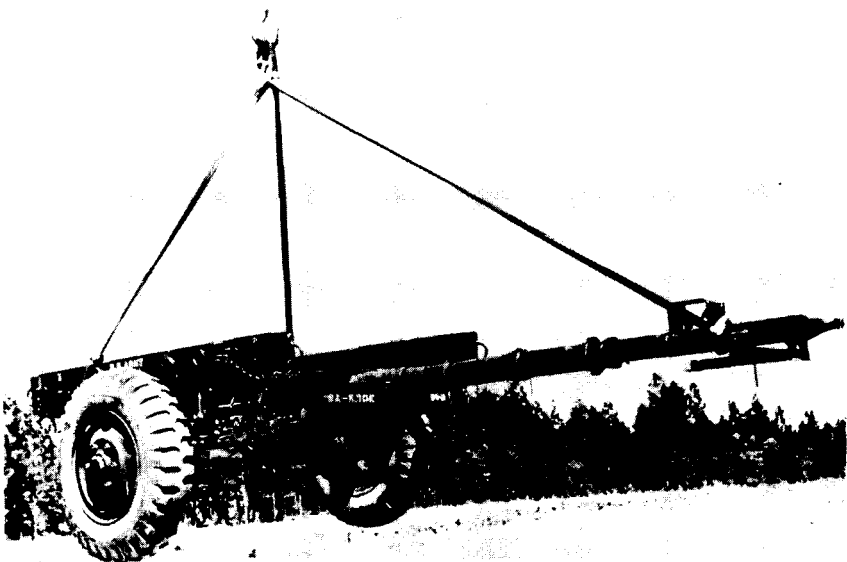


Figure 75. Trailer, 2½-ton, pole, 2W (weight—1,750 pounds).

- (2) Connect sling ends with large dual clevis.
- (3) When two track lengths as illustrated are to be carried, they are rigged separately and then connected by a large dual clevis at apex of slings.

47. Honest John Rocket System, Type Load I, Warhead on Skid and Cart w/Rocket Handling Beam, Gantry and Hoist

Use figure 77 as a guide and proceed as follows:

a. Preparation.

- (1) Mount warhead, skid, beams, and gantry on cart.
- (2) Place hoist in canvas bag and secure to cart.
- (3) Lash all items securely to cart using integral straps.
- (4) Secure tow bar in "up" position.

Caution: Sufficient lashings are necessary to prevent warhead from shifting on card.

b. Rigging.

- (1) Loop four 8-foot slings around cart frame as shown.
- (2) Pad sharp edges of frame under slings.
- (3) Secure four loose ends of slings to large clevis.
- (4) Pad (not shown) top of warhead to prevent damage by falling clevis.

Warning: Discharge static electricity from cargo hook before hookup of live warhead.

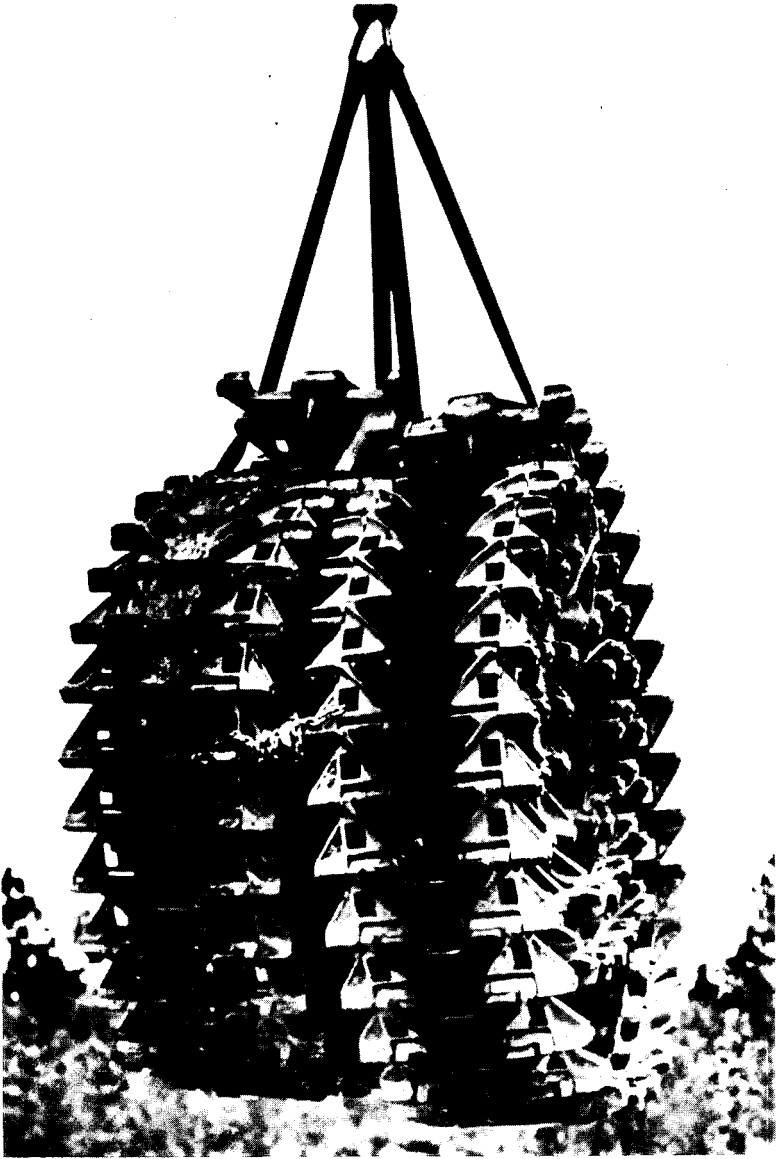
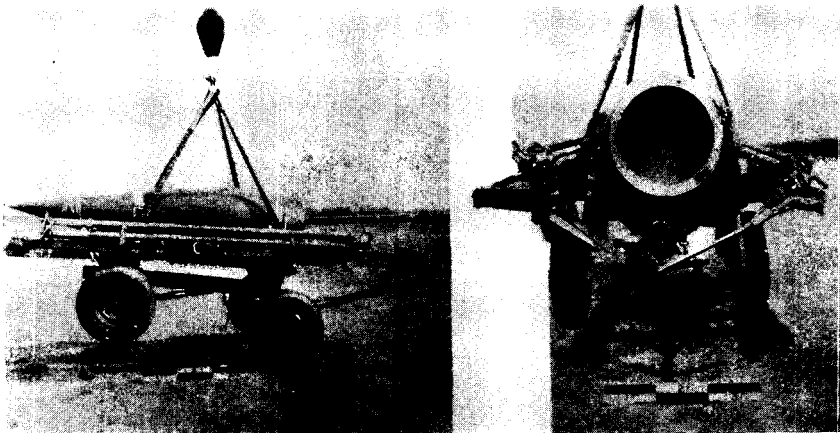


Figure 76. Tank tracks (weight varies with length and type).



Type load I (warhead on skid and cart w/rocket handling beam, gantry, and hoist; weight—3,200 pounds)

Figure 77. Honest John Rocket System.

48. Honest John Rocket System, Type Load II, Improved Motor on Skid

Use figure 78 as a guide and proceed as follows:

a. Preparation.

- (1) Mount motor on skid.
- (2) Secure with integral straps.

b. Rigging.

- (1) Rig so as to fly nozzle forward.
- (2) Loop 7-foot slings around skid braces at fin end.
- (3) Loop 8-foot slings around skid braces at nose end.
- (4) Secure all slings to skid frame to prevent slipping.
- (5) Secure four loose sling loops to large clevis.
- (6) Pad top of motor.

Warning: Discharge static electricity from cargo hook before hookup of live warhead.

49. Honest John Rocket System, Type Load III, Honest John Launcher (Mockup)

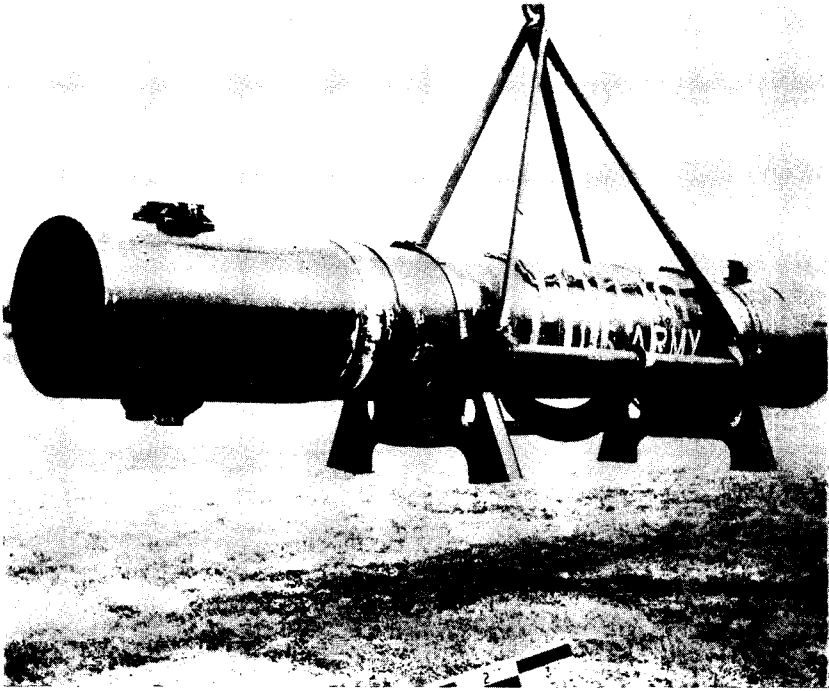
Use figure 79 as a guide and proceed as follows:

a. Preparation.

- (1) Secure jacks in "up" position.
- (2) Secure tow bar in "up" position.

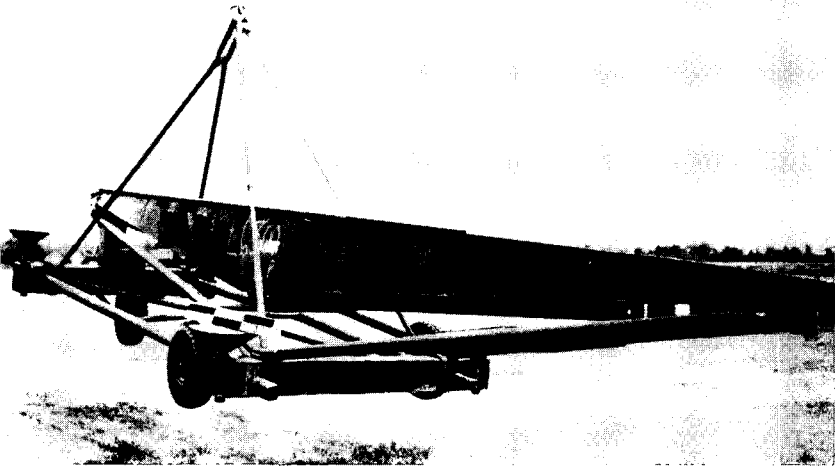
b. Rigging.

- (1) Loop four 12-foot slings around end beams.
- (2) Lace a 5-foot sling through ends of forward suspension slings.



Type load II (Improved motor on skid ; weight—3,300 pounds)

Figure 78. Honest John Rocket System.



Type load III (Honest John Launcher (mockup) ; weight—3,260 pounds)

Figure 79. Honest John Rocket System.

- (3) Attach four loose ends to large clevis.
- (4) Pad (not shown) top of launcher rail to prevent damage by falling clevis.

Caution: Avoid dragging during takeoff and landing.

50. Wind Set and Crew, Little John and Honest John Rockets

Use figure 80 as a guide and proceed as follows:

- a. *Preparation.* Lash complete wind set in carrier.
- b. *Rigging.*
 - (1) Attach large clevis or 2-foot sling at apex of integral suspension ropes.
 - (2) Tape plywood strips on top of mast to prevent damage by falling clevis.



Figure 80. Wind set and crew, Little John and Honest John Rockets
(weight—2,485 pounds).

- (3) Attach clevis to cargo hook.
- (4) Have crew board helicopter.

Note. Hookup is effected with aircraft on the ground beside the load; however, landing is made in normal manner by releasing load while hovering.

51. Little John Rocket, Mounted on Rocket Launcher

Use figure 81 as a guide and proceed as follows:

a. Preparation.

- (1) Secure rocket on launcher in normal manner.
- (2) Pad top of rocket to prevent damage by falling clevis.
- (3) Secure front jack in "up" position.
- (4) Secure outriggers in "travel" position.

b. Rigging.

- (1) Loop 11-foot slings around front suspension bars and draw tight.
- (2) Use tie-down strap between loops to prevent load from slipping off bars (A).
- (3) Use tie-down strap through lifting eyes to loops to prevent slipping together.
- (4) Loop 9-foot slings around rear suspension bars and secure in the same manner.
- (5) Secure all four loose ends on large clevis or 2-foot sling.

Caution: Do not drag load during pickup or landing since launcher rail may dig into ground.

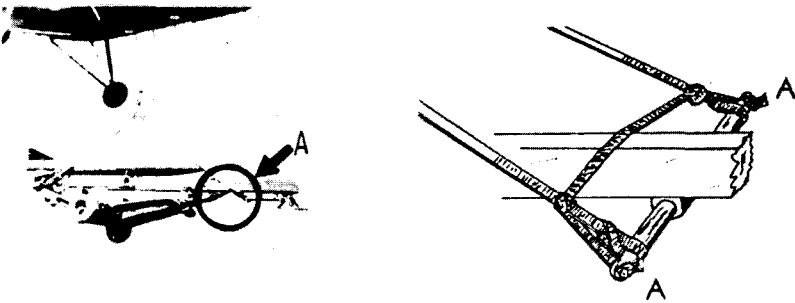


Figure 81. Little John Rocket, mounted on rocket launcher
(weight—2,579 pounds).

52. Little John Rocket Tactical Crate w/Rocket

Use figure 82 as a guide and proceed as follows:

Warning: This load is unstable in flight and becomes dangerous above 30 knots indicated airspeed. Exercise extreme caution when flying this load.

a. Preparation. Secure rocket in crate and lock crate in normal manner.

b. Rigging.

- (1) Cradle crate in two 12-foot slings by centering slings under crate and inserting ends up through end gap in top bracing.
- (2) Attach four sling ends to large dual clevis.

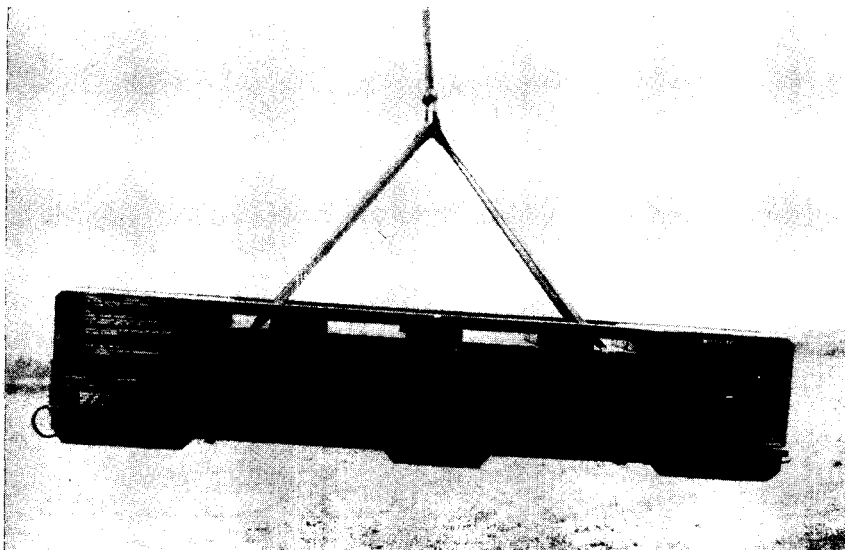


Figure 82. Little John Rocket tactical crate w/rocket (weight—1,500 pounds).

53. Little John Rocket Mounted on Rocket Trailer

Use figure 83 as a guide and proceed as follows:

a. Preparation.

- (1) Secure rocket on trailer in normal manner.
- (2) Pad top of rocket to prevent damage by falling clevis.
- (3) Secure front jack in "up" position.
- (4) Secure lifting bars on cart.

b. Rigging.

- (1) Loop 7-foot slings into channels of front and rear suspension bars.
- (2) Use tie-down strap (not shown) between loops to prevent load from slipping off bars.
- (3) Use tie-down strap (not shown) through shackle to loops to prevent slipping together.
- (4) Secure all four loose sling ends on large clevis or 2-foot sling.

Caution: Do not drag load during pickup or landing as rail may dig into ground.

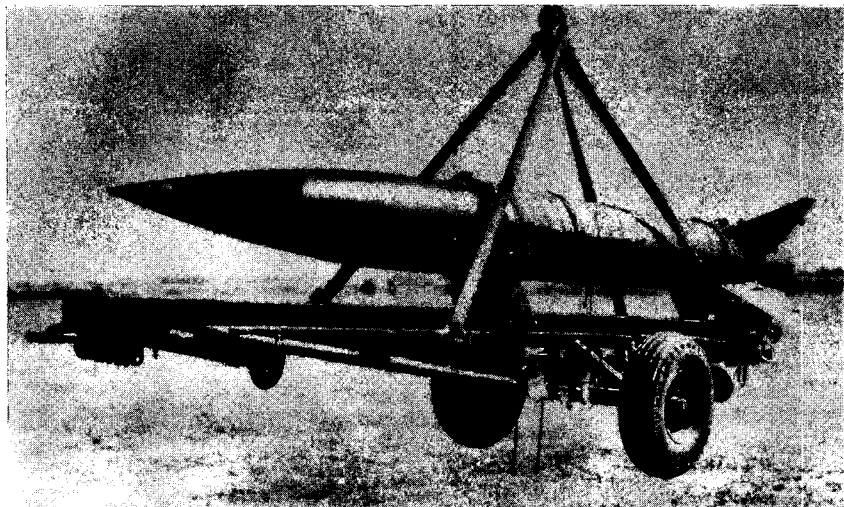


Figure 83. *Little John Rocket mounted on rocket trailer (weight—1,098 pounds).*

54. Boats, Assault, M2 (Six Nested)

Use figure 84 as a guide and proceed as follows:

a. Preparation.

- (1) Nest required number of boats bottom down.
- (2) Lash paddles, motors, etc., in top boat.

b. Rigging.

- (1) Center 20-foot sling under bottom boat and run sling ends up through second handgrip from front.
- (2) Center 20-foot sling under bottom boat and run sling ends up through second handgrip from rear.
- (3) Loop a 5-foot sling into each end of each 20-foot sling in the manner indicated to form extensions to the 20-foot sling.
- (4) Join four sling ends with a dual clevis.

55. Boat, Bridge Erection, 19-Foot With Cradle

Use figure 85 as a guide and proceed as follows:

a. Preparation.

- (1) If boat is to be landed in water, remove all lashings between boat and cradle before rigging.
- (2) If boat is to be landed on land, secure cradle to boat using integral lashing cables.
- (3) Lash canvas securely over control panel and steering wheel to prevent cable from fouling during takeoff.
- (4) Inspect integral lifting sling for damage.

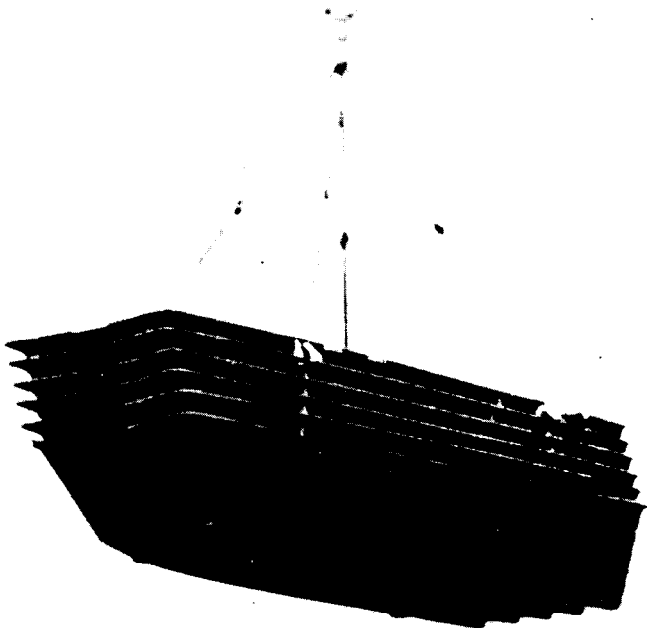


Figure 84. Boats, assault, M2 (six nested) (weight—2,600 pounds w/paddles).

b. Rigging.

- (1) Loop 5-foot sling through integral lifting eye.
- (2) Attach large clevis to 5-foot sling.

Caution: During takeoff without cradle, the helicopter should lift vertically until a ground observer has signalled that the boat is well clear of the cradle.

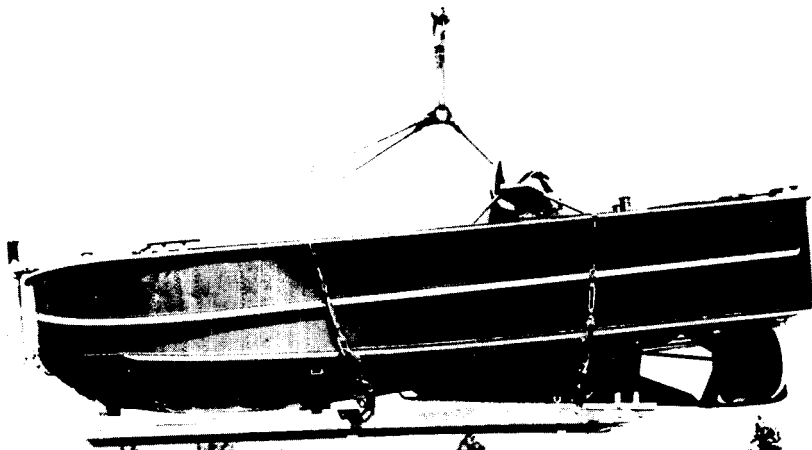


Figure 85. Boat, bridge erection, 19-foot w/cradle (weight—3,400 pounds).

56. Footbridge, Aluminum—Type Load I

Note. Four hundred feet of footbridge require one sortie of type load I; one sortie, type load II; two sorties, type load III.

Use figure 86 as a guide and proceed as follows:

a. Preparation.

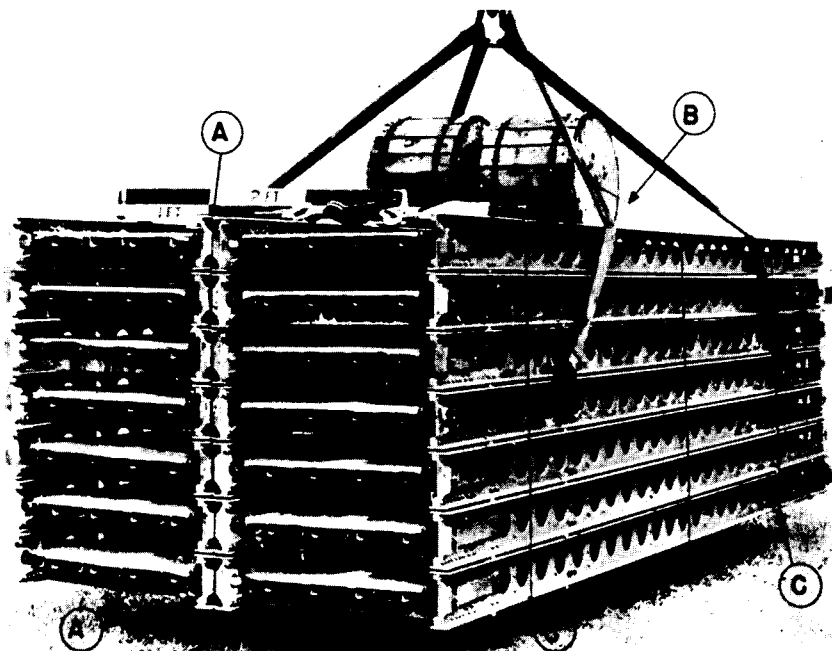
- (1) Stack 2 rows of 7 treadways each in such a manner that the boltheads on top of side frame stringers will nest in holes provided in bottom of stringer above. Be sure that rows are even and fit snugly against each other. Stack on dunnage to permit entry under load.
- (2) Lace light rope through holes in inboard stringer ends of all 14 treadway sections. Draw rope snugly and tie at points (A).

Note. When load is lifted, a gap may appear between the fourth and fifth sections from the top. This will cause no difficulty provided rope has been laced between sections (A).

- (3) Center one reel of cable on top of each stack.

b. Rigging.

- (1) Use two B-1 tie-down cables through cable reels and around entire load (B).
- (2) Use additional B-1 tie-down cables around entire load (C).



Type load I (weight—1,470 pounds)

Figure 86. Footbridge, aluminum.

- (3) Draw all cables *tight*.
- (4) Center 192-inch aerial delivery cargo slings through holes indicated and connect ends with large dual clevis.
- (5) Pad points where slings contact sharp edges.

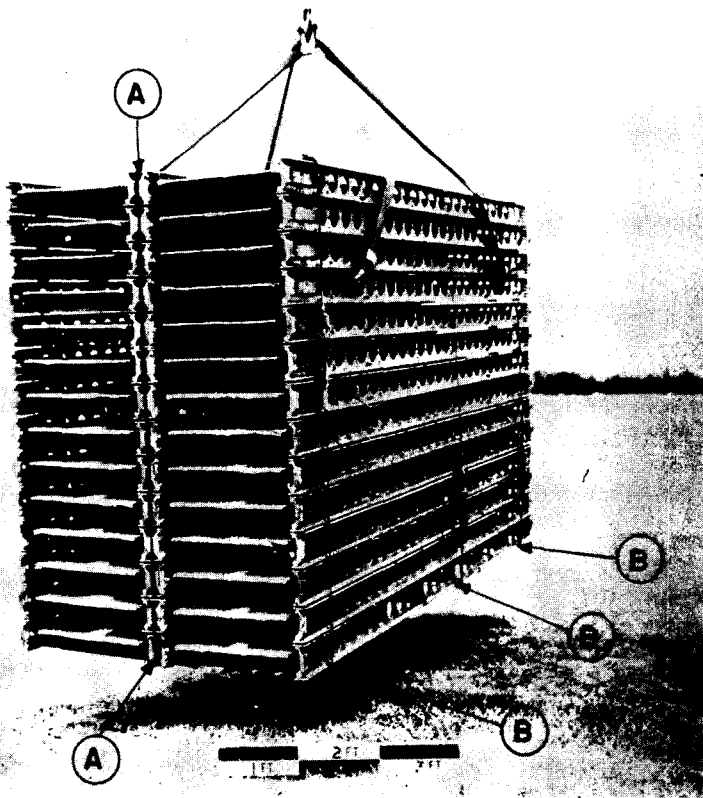
57. Footbridge, Aluminum—Type Load II

Use figure 87 as a guide and proceed as follows:

a. Preparation.

- (1) Stack 2 rows of 14 treadway sections each in such a manner that the boltheads on top of side frame stringers will nest in hole provided in bottom of next higher stringer. Be sure that rows are even and fit snugly against each other. Stack on dunnage to permit entry under load.
- (2) Lace light rope through holes in inboard stringer ends of all 28 treadway sections. Draw rope tight and tie at points (A).

Note. When load is lifted, a gap may appear between the fourth and fifth sections from the top. This will cause no difficulty provided rope has been laced between points (A).



Type load II (weight—2,240 pounds)

Figure 87. Footbridge, aluminum.

b. Rigging.

- (1) Use B-1 tie-down cables around entire load at points (B).
- (2) Draw all cables *tight*.
- (3) Center 192-inch aerial delivery cargo sling through holes indicated and connect at apex with large dual clevis.
- (4) Pad points where webbing crosses sharp corners.

58. Footbridge, Aluminum—Type Load III—21 Pontons

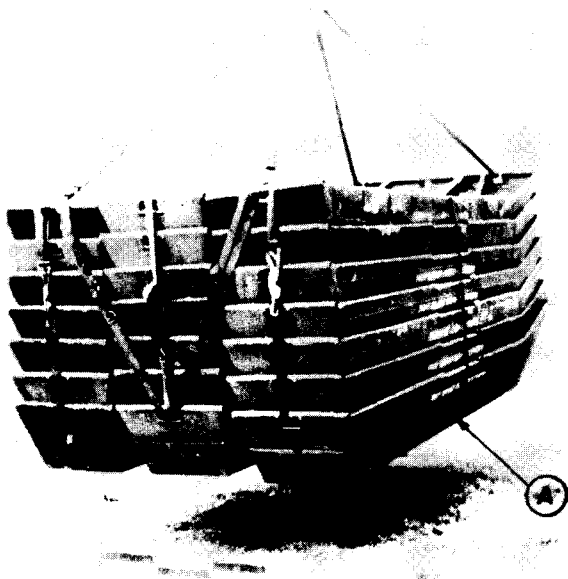
Use figure 88 as a guide and proceed as follows:

a. Preparation.

- (1) Stack 3 rows of 7 pontons on dunnage, each nested as indicated.
- (2) Lash miscellaneous bridge components in top three pontons.

b. Rigging.

- (1) Use 5 tie-down straps with tensioning device on each end of load to tie top 3 pontons to bottom 3 pontons in the manner illustrated. Tighten.
- (2) Use tie-down strap with tensioning device around entire load (A).
- (3) Loop 8-foot slings around handgrip of each top, with outboard ponton on upstream end.
- (4) Loop 9-foot slings around handgrip of each top, with outboard ponton on downstream end.
- (5) Connect four slings at apex by means of large dual clevis.



Type load III—21 pontons (weight—2,160 pounds)

Figure 88. Footbridge, aluminum.

59. Bridge, Floating, M4T6—Type Load I

Use figure 89 as a guide and proceed as follows:

a. Preparation.

- (1) Assemble ponton *without* joining two halves with center beams.
- (2) Lash one center beam on top of each half ponton.
- (3) Inspect for proper air pressure in all sections.

b. Rigging.

- (1) Loop 14-foot sling around each end of outrigger bar. Lash to outrigger beams to prevent slipping inboard. Join and extend by centering in 5-foot sling.
- (2) Cradle aft end of center pneumatic float by centering a 192-inch aerial delivery cargo sling under float and lead sling forward over top of outboard pneumatic floats.
- (3) Connect two 20-foot slings by joining loop ends. Run under ponton and center at point (A).
- (4) Lead ends of 40-foot sling through loop ends of a 192-inch aerial delivery cargo sling.
- (5) Connect ends of 40-foot sling and ends of 5-foot sling at apex by use of a large dual clevis.

Note. Much of the weight of this load is carried by the rear floats of the ponton. This results in considerable stress in this area.

60. Bridge, Floating, M4T6—Type Load II (One Bay Saddle Adapters, Transverse Stiffeners, and Balk)

Use figure 90 as a guide and proceed as follows:

Warning: No safe method has been devised whereby this assembly may be placed in its ponton section by helicopter and, therefore, this type placement should not be attempted.

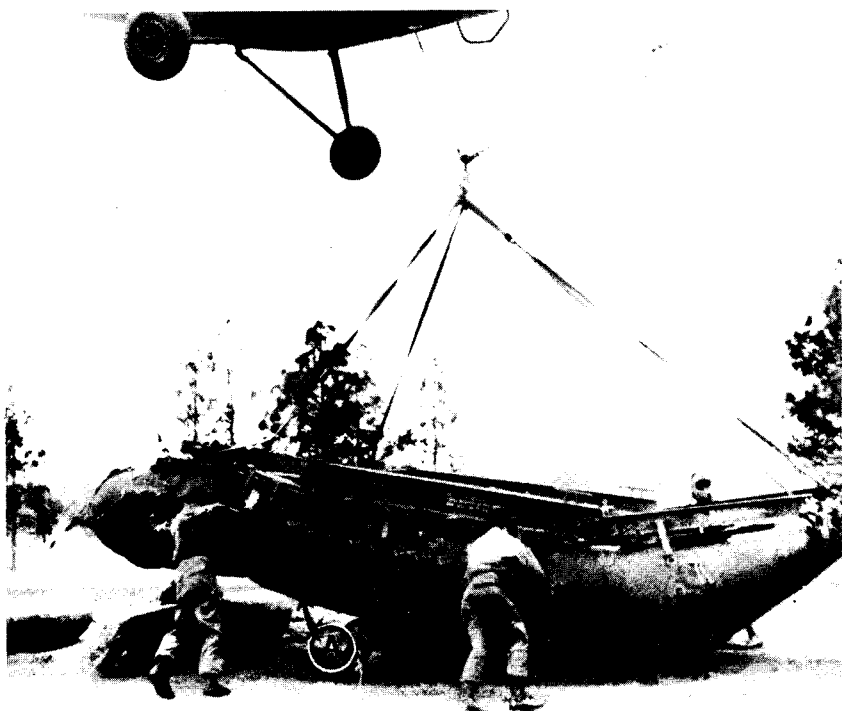
a. Preparation.

- (1) Assemble saddle adapters, transverse stiffeners, and regular balk. Vary the amount of balk to achieve the weight the helicopter can carry under the prevailing conditions.
- (2) Inspect to see that all locking drift pins are seated and locked.

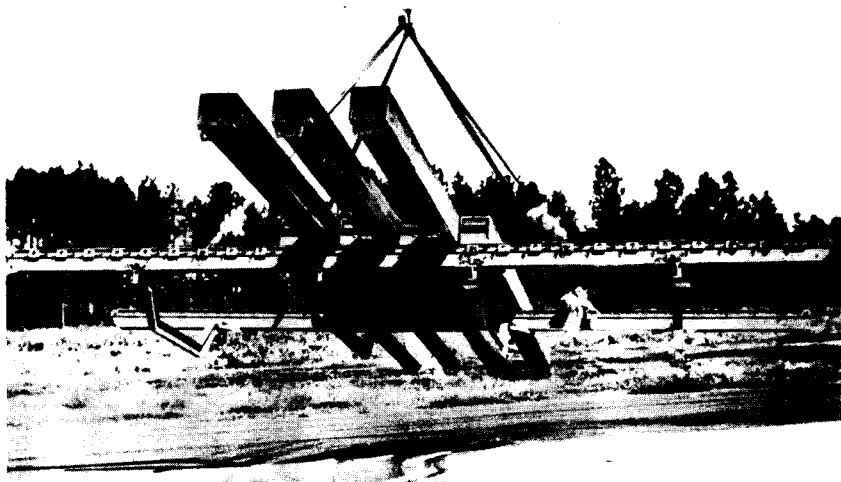
b. Rigging.

- (1) Attach 8-foot slings to one transverse stiffener outboard of balk by running drift pins through loop ends of slings.
- (2) Attach 9-foot slings to other transverse stiffener in the same manner.
- (3) Join four slings at apex by means of large dual clevis.
- (4) Pad where slings contact sharp corners.

Note. Rigging in this manner will result in one end of the balk riding high as indicated. This end is intended to ride forward.



Type load I (weight—2,795 pounds)
Figure 89. Bridge, floating, M4T6.



Type load II (one bay saddle adapters, transverse stiffeners, and balk ;
 weight—2,900 pounds)

Figure 90. Bridge, floating, M4T6.

61. Bridge, Floating, M4T6—Type Load III (16 Short Balk)

Use figure 91 as a guide and proceed as follows:

a. Preparation.

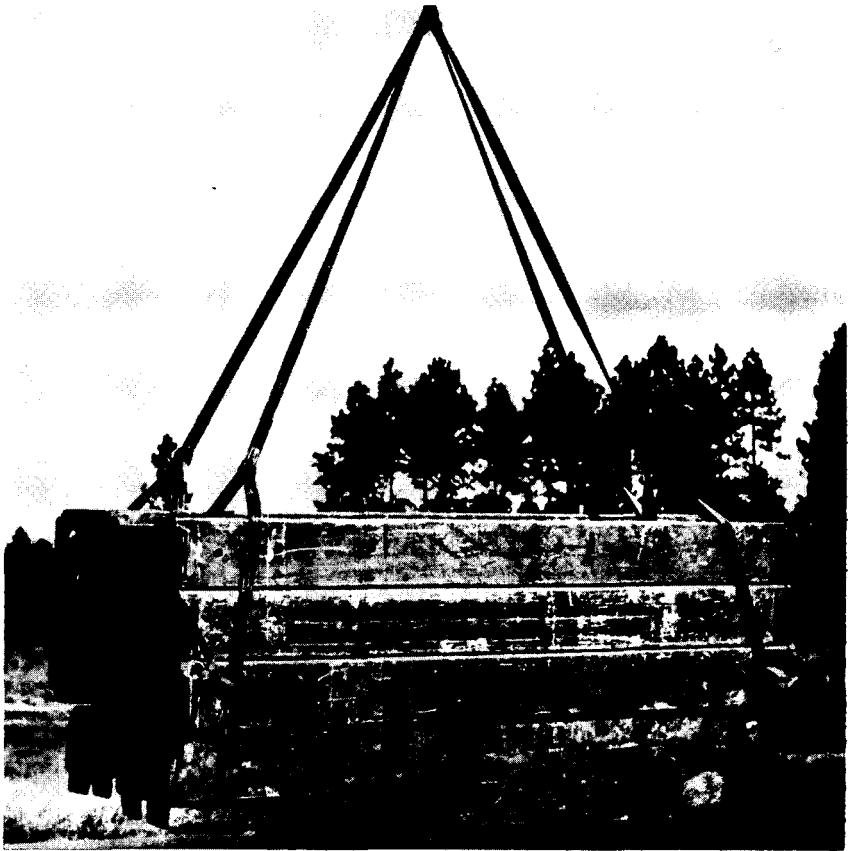
- (1) Place two balk together on ground with lugs down to act as dunnage.
- (2) Stack six balk on top with lugs facing outward.
- (3) Prepare a second stack of eight balk in the same manner.

Note. Number of balk may be varied to meet weight capability of the helicopter under the prevailing conditions.

b. Rigging.

Caution: Apply rigging in a manner to prevent the lugs of one stack of balk from cutting webbing on the other stack.

- (1) This load is rigged as two identical loads connected at the apex to form a single load.



Type load III (16 short balk ; weight—2,400 pounds)

Figure 91. Bridge, floating, M4T6.

- (2) Loop one 192-inch aerial delivery cargo sling around each end of each stack of eight balk.
- (3) Lash slings to ends of balk by means of tie-down straps to prevent slings slipping on balk.
- (4) Connect four slings at apex by means of large dual clevis.

62. Bridge, Floating, M4T6—Type Load IV (2 Bearing Plates; 7 Balk, Regular; 3 Transverse Stiffeners)

Use figure 92 as a guide and proceed as follows:

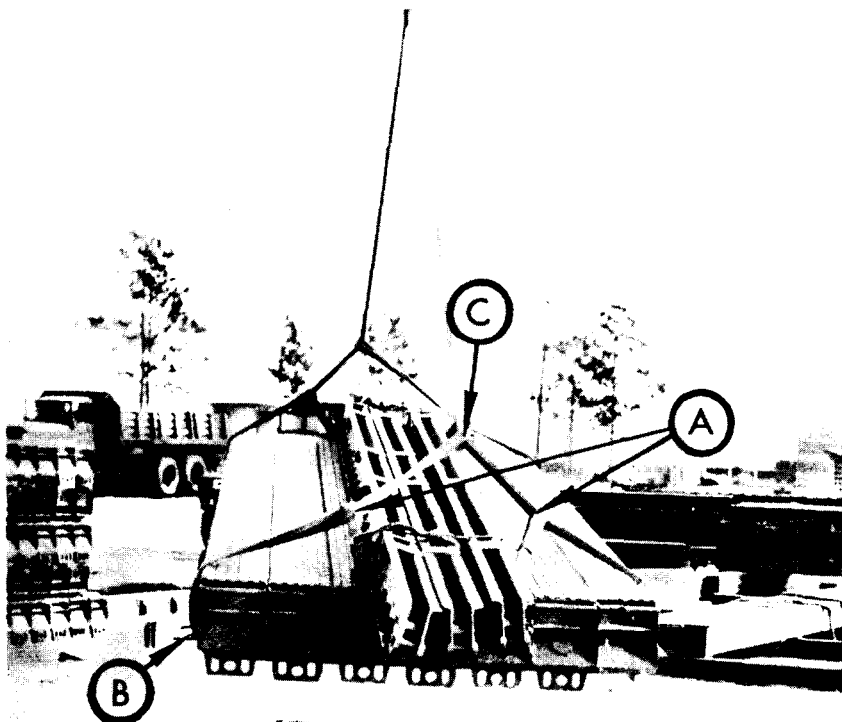
a. Preparation.

Note. Numerous combinations of items are possible with this type load.

- (1) Use two bearing plates as a base on which to lay balk, regular.
- (2) Center three transverse stiffeners on top of balk.
- (3) Lash transverse stiffeners to balk with tie-down straps.

b. Rigging.

- (1) Cradle ends of transverse stiffeners with 5-foot slings.
- (2) Center lace 20-foot slings under each end of balk, through ends of 5-foot slings (A), and through handgrips of bearing plates (B).



Type load IV (2 bearing plates; 7 balk, regular; 3 transverse stiffeners; weight—2,785 pounds)

Figure 92. Bridge, floating, M4T6.

- (3) Loop another 20-foot sling (C) through ends of 20-foot sling discussed in (2) above. Repeat this operation on other end of balk.
- (4) Join these two 20-foot slings at apex by means of large dual clevis.
- (5) Pad all sharp edges under slings.

63. Bridge, Floating, M4T6—Type Load V (Assorted Balk)

Use figure 93 as a guide and proceed as follows:

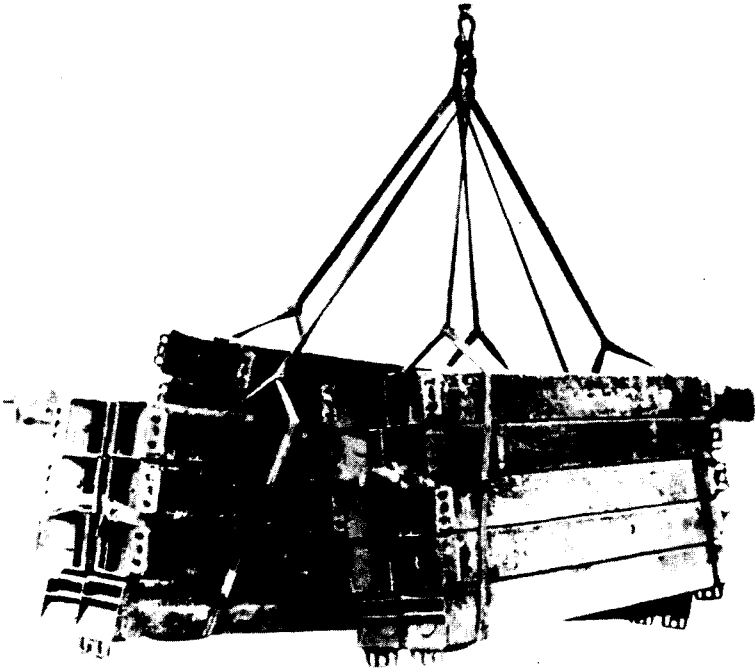
a. Preparation.

- (1) Place two balk together on ground with lugs down to act as dunnage.
- (2) Stack balk on top with lugs facing outward.
- (3) Prepare additional stacks in the same manner.

Note. Number of balk may be varied to meet weight capability of the helicopter under the prevailing conditions.

b. Rigging.

Caution: This load is rigged as two or more separate loads connected at the apex to form a single load. Apply rigging so as to prevent the lugs of one stack of balk from cutting webbing on the other stack.



Type load V (assorted balk ; weight dependent on number of balk used)

Figure 93. Bridge, floating, M4T6.

- (1) Loop one 192-inch aerial delivery cargo sling around each end of each stack of short balk.
- (2) Loop one 20-foot sling around each end of each stack of regular balk.
- (3) Lash slings to end of balk by means of tie-down straps.
- (4) Connect slings at apex by means of large dual clevis.

64. Bridge, Floating, M4T6—Type Load VI—Aluminum Bridge Balk, Regular

Use figure 94 as a guide and proceed as follows:

Warning—Danger: This load is unstable in flight and is very dangerous above 30 knots indicated airspeed. This load should be flown only with extreme caution.

a. Preparation. Stack 10 lengths of balk on dunnage as indicated.

b. Rigging.

- (1) Loop two 192-inch aerial delivery cargo slings around ends of entire load.
- (2) Lash slings to end lugs to prevent slipping.
- (3) Use large dual clevis at apex of slings.

65. Bridge, Panel, M2—Type Load I

Use figure 95 as a guide and proceed as follows:

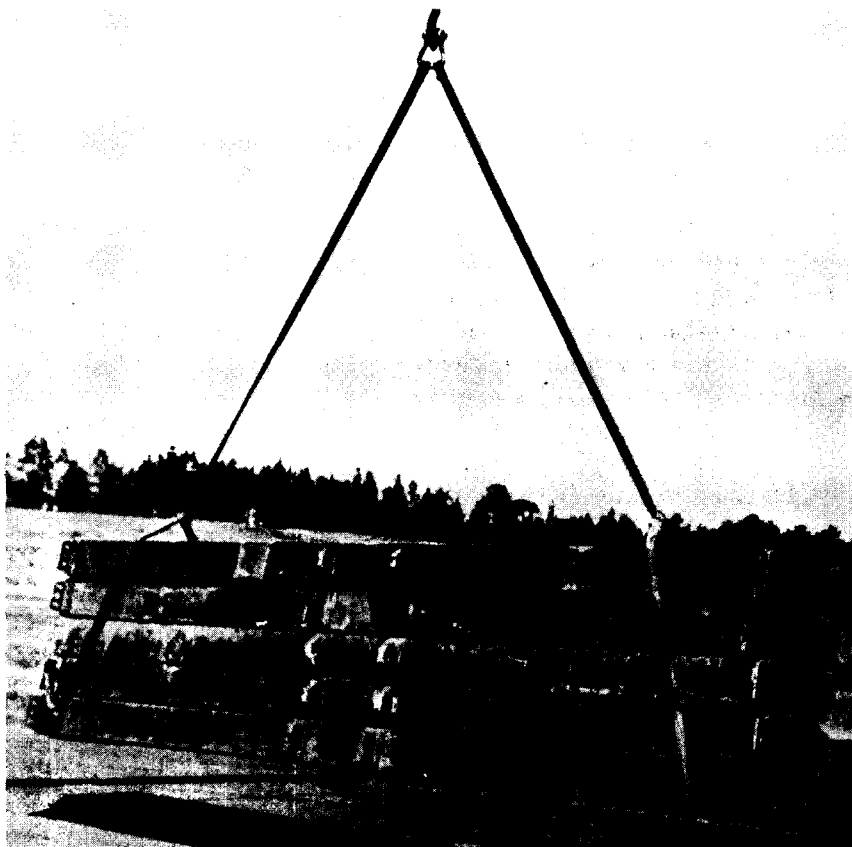
a. Preparation. Lay out all items. Secure jack handles to jacks.

4 base plates	@ 381 lbs=	1,524 lbs
4 bearings	@ 68 lbs=	272 lbs
2 jacks w/hdls	@ 128 lbs=	256 lbs
2 jack shoes	@ 36 lbs=	72 lbs
4 templates rocking	@ 78 lbs=	312 lbs
4 templates plain	@ 22 lbs=	88 lbs
4 carry tongs, 2 carry bars		68 lbs

2,592 lbs

b. Rigging.

- (1) Lay out nylon cargo net, 3,000 pound capacity.
- (2) Center on net one base plate, flat side down.
- (3) Lay two jacks with handles on opposite corners of base plate.
- (4) Lay next base plate on top, lifting eyes down.
- (5) Lay next base plate on top, flat side down.
- (6) Lay on top of third base plate, 2 jack shoes and 2 bearings.
- (7) Lay fourth base plate on top, lifting eyes down.
- (8) Build up remainder of items ending with carrying bars and tongs on top.
- (9) Lash four base plates together using 15-foot webs with binders.



Type load VI (aluminum bridge balk, regular weight 2,000 pounds)

Figure 94. Bridge, floating, M4T6.

- (10) Lash across top of load two diagonal 15-foot lashings, through lifting eyes of third and fourth base plates.
- (11) Draw all slack out of net. Thread 15-foot web through net, crisscross ends over top of load and bind.
- (12) Attach suspension: Lace two 15-foot slings through lifting eyes of first and second base plates, threaded back through own loops at top of load.
- (13) Attach dual clevis.

66. Bridge, Panel, M2—Type Load II

Use figure 96 as a guide and proceed as follows:

a. *Preparation.* Lay out all items.

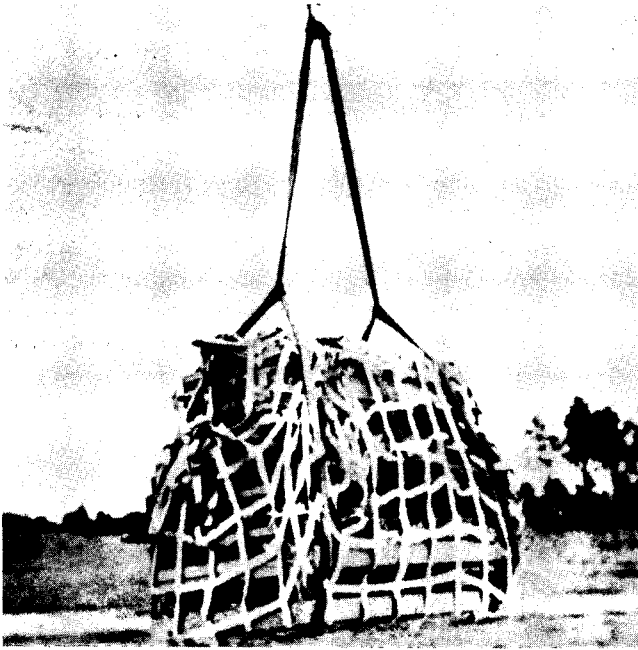
3 transoms

@ 618 lbs=1,854 lbs

4 plain stringers

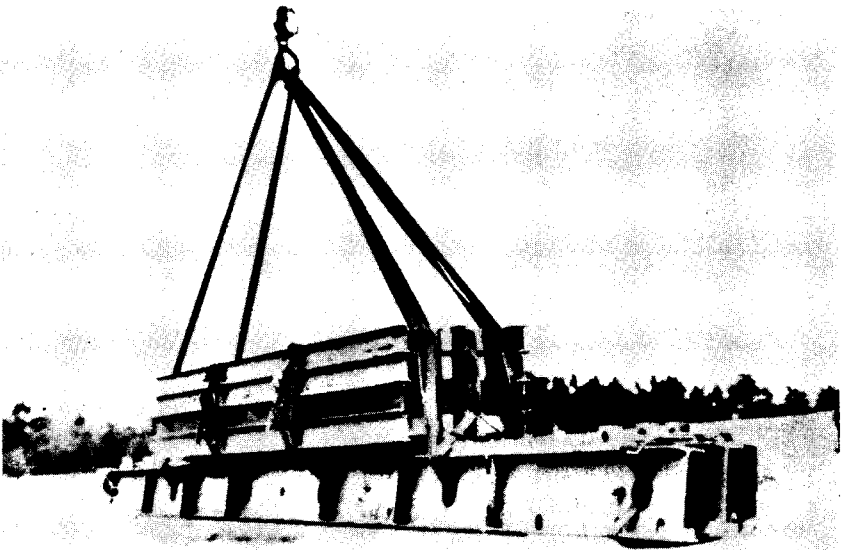
@ 260 lbs=1,040 lbs

2,894 lbs



Type load I; weight—2,610 pounds

Figure 95. Bridge, panel, M2.



Type load II; weight—2,900 pounds

Figure 96. Bridge, panel, M2.

b. Rigging.

- (1) Place transoms side by side with the ends alined in an upright position.
- (2) Lash ends through lightening holes with 15-foot lashing at each end.
- (3) Center stringers on sides on top of transoms.
- (4) Lash stringers to transoms with two 15-foot lashings through center lightening holes of transoms, across stringers. Lash two 15-foot tie-down straps through second lightening holes (from ends) of transoms lengthwise over stringers.
- (5) Attach two 20-foot suspension slings looped twice through second lightening holes from ends of transoms.
- (6) Attach dual clevis.

67. Bridge, Panel, M2—Type Load III

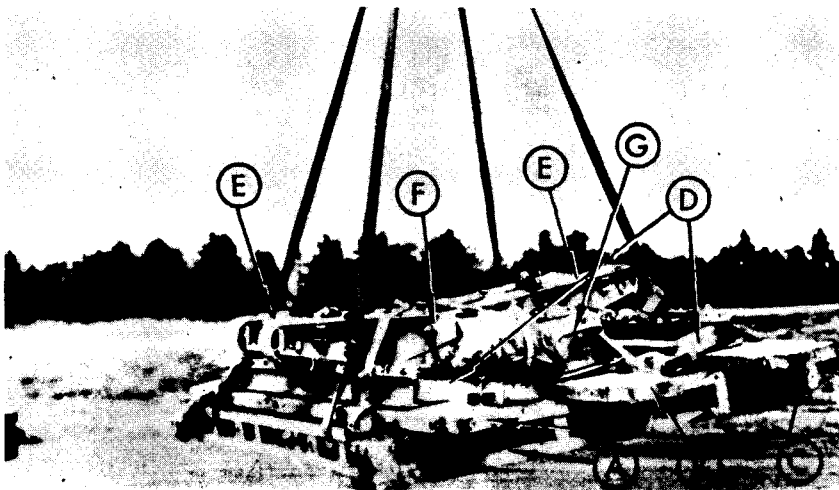
Use figure 97 as a guide and proceed as follows:

a. Preparation.

- (1) Attach end posts to panel.
- (2) Place all small items in carry bags.
- (3) Lay out the following items:
 - 1 panel with end posts
 - 3 chess
 - 4 rocking rollers
 - 4 plain rollers
 - 2 button stringers
 - 12 J bolts
 - 4 transom clamps in bag
 - 8 bracing bolts in bag
 - 2 launching links in bag

b. Rigging.

- (1) With panel (A) on side, lay one chess (B) lengthwise along centerline. Lay others (C) so each touches cap or sill.
- (2) Place stringers (D) with sides against center chess.
- (3) Center rocking rollers (E) across load with two extending over each side.
- (4) Lay one plain roller (F) on center line crosswise against rocking rollers at each end.
- (5) Lay other rollers (G) lengthwise along centerline ends against and across the plain rollers.
- (6) Using 15-foot straps, lash as follows:
 - (a) Across load, through panel, on each of stringers (4 lashings).
 - (b) Across rocking rollers around center bar of each stringer (2 lashings).



Type load III ; weight—3,250 pounds

Figure 97. Bridge, panel, M2.

- (c) Diagonally across load (4 lashings).
- (d) Lengthwise across load through handles of plain rollers and tool bags (1 lashing).
- (7) Attach four 9-foot suspension slings through slots in cap and sill of panel around stringers.
- (8) Attach dual clevis.

68. Bridge, Panel, M2—Type Load IV

Use figure 98 as a guide and proceed as follows:

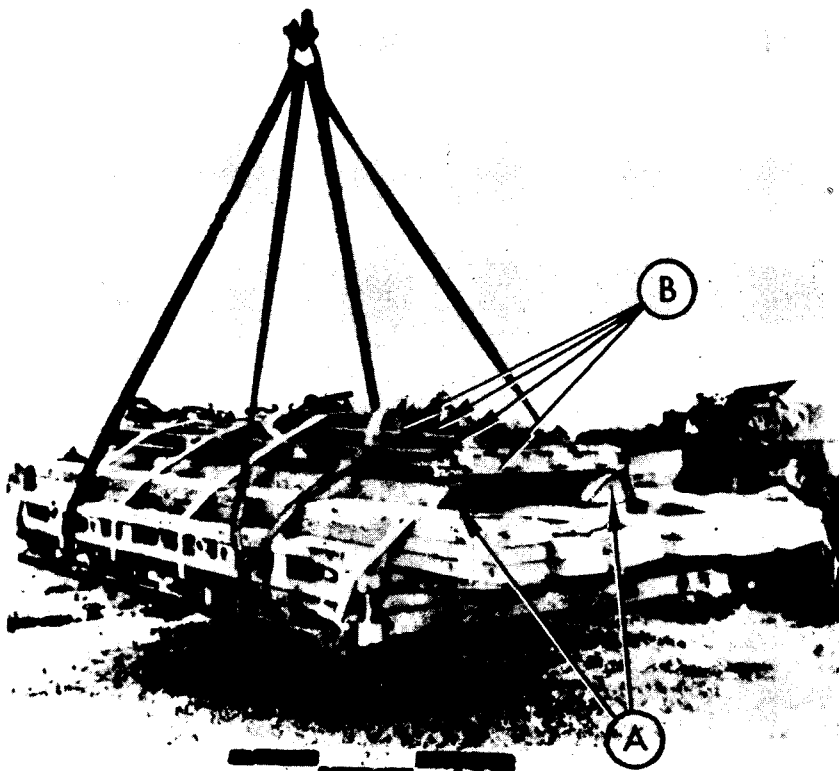
a. Preparation.

- (1) Place panel pins and safety pins in carry bag.
- (2) Lay out the following items:
 - 1 panel with one male and one female end post attached
 - 10 chess
 - 2 ribands
 - 4 rakers
 - 2 sway braces in bags
 - 8 panel pins in bags
 - 8 safety pins in bags

b. Rigging.

- (1) With panel on dunnage four inches high (to permit securing lashings), lay chess two high lengthwise on top of panel. Start with first two centered along long axis of panel.

Caution: Short axis centerlines of chess and panels must be alined for balance.



Type load IV; weight—3,020 pounds

Figure 98. Bridge, panel, M2.

- (2) Place ribands (A) on top of outside chess with flat edge of riband even with outside edge of chess.
- (3) Lay out two 15-foot lashings across ribands and chess.
- (4) Place rakers, sway braces and carry bag on top of lashings (B). Bind together.
- (5) Secure entire load by lashing diagonally across top and through diagonal braces on panel and across short dimension at each end.
- (6) Cross tie ends of chess with one 15-foot lashing at each end.
- (7) Attach four 9-foot suspension slings through slots in cap and sill of panel.
- (8) Attach dual clevis.

69. Pack, Medical Disaster, Typical

Use figure 99 as a guide and proceed as follows:

a. Preparation.

- (1) Lash equipment for operating room, post-operative ward, etc., on separate 6,000-pound cargo platforms.

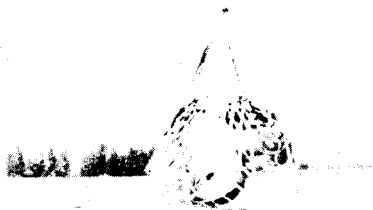
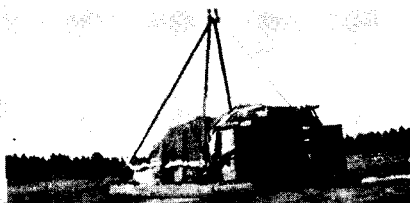


Figure 99. Pack, medical disaster, typical, utilizing 6,000-pound platform and nylon cargo net; weight—variable.

- (2) Soft items such as blankets, etc., should be loaded in cargo net.

b. Rigging.

- (1) Attach 6-foot slings to lifting points. Longer slings should be employed if necessary to avoid slings touching load under tension.
- (2) Attach four slings at apex with large dual clevis.
- (3) Padding should be provided if equipment is of a nature to be damaged by the falling clevis.

Warning: Tarpaulin cover may be used over equipment if necessary for protection from the weather, but it *must* be lashed securely to prevent billowing or flapping in flight. A loose cover will cause the platform to oscillate violently.

INDEX

	Paragraph	Page
Acquisition, target.....	117, 118	58
ACR (aerial combat reconnaissance) (<i>see also</i> Air mobility for land reconnaissance).....	54-57	30
Active defense of Army airfields.....	323	165
Aerial:		
Combat reconnaissance (ACR) (<i>see also</i> Air mobility for land reconnaissance).....	54-57	30
Observation. (<i>See</i> Observation, aerial.)		
Photo training.....	92	46
Photography. (<i>See</i> Photography, aerial.)		
Position area reconnaissance (<i>see also</i> Reconnaissance, aerial).....	98	48
Reconnaissance. (<i>See</i> Reconnaissance, aerial.)		
Surveillance. (<i>See</i> Surveillance, aerial.)		
Aeromedical evacuation:		
Advantages.....	137	69
Ambulance units (Army Medical Service).....	138-141	69
Capabilities of nonmedical aviation units.....	142-145	72
Requests for emergency type.....	146a	73
SOP for establishing priorities for.....	147	73
Training.....	148, 149	74
Aircraft:		
Defense. (<i>See</i> Defense of aircraft.)		
Identification (Indian names).....	(app. II)	213
Air delivered reconnaissance elements (<i>see also</i> Air mobility for land reconnaissance).....	58-75	31
Airfields, Army. (<i>See</i> Army airfields and landing areas.)		
Air-ground panel codes.....	(app. XI)	244
Airlanded operations, unilateral.....	45	23
Airlift:		
For troop movement.....	43-45	22
Basic considerations.....	43c	22
Capabilities and limitations.....	44	23
Requirements.....	43b	22
Training.....	46, 47	25, 26
Unilateral airlanded operations.....	45	23
Of equipment and supplies.....	48-51	26
Delivery responsibilities.....	49	26
Methods of delivery.....	51	27
Training.....	52, 53	28, 29
Types of supplies.....	50	27

	Paragraph	Page
Air mobility for land reconnaissance:		
Aerial combat reconnaissance (ACR).....	54-57	30
Battle drills.....	57	31
Unit concept.....	54	30
Unit concepts of employment.....	56	30
Unit mission capabilities.....	54-55	30
Air delivered reconnaissance elements.....	58-75	31
Aircraft disposition after delivery.....	66	34
Classification of.....	58	31
Command of.....	60	32
Communications.....	72	37
Coordination of reconnaissance plan.....	65	34
Factors governing type aircraft used by.....	62	32
Landing site selection.....	69a	36
Low level navigation required for.....	67	34
Mission.....	58b	31
Organization.....	59	31
Parking site characteristics, organization and camou- flage.....	69b, d	36, 37
Patrol withdrawal.....	70	37
Planning considerations.....	63	32
Reconnaissance of objective area prior to movement of.....	64	34
Responsibilities for employment of.....	61	32
Techniques used to penetrate enemy area.....	68	34
Training.....	73-75	38
Air reconnaissance.....	294b	148
Airsickness.....	369b	192
Air traffic control.....	285-289	142
Functions.....	285	142
Identification measures.....	288	144
Measures.....	286	142
Terminal control operation.....	289	144
Types of.....	287	142
Amphibious operations.....	230-237	118
Area reconnaissance training.....	91a	46
Armor protection of Army aircraft.....	195	100
Army airfields and landing areas:		
Classes.....	292	147
Criteria for site selection.....	295-307	148
Description.....	290	146
Instrument approach factors.....	308, 309	153, 154
Lighting of.....	320, 321	163
Occupation and organization.....	310-313	154
Reconnaissance for.....	293	147
Requirements for night operations.....	207, 208	106
Seaplane facilities.....	314-319	157
Security of.....	322-324	165
Types.....	291	146
Army Aviation:		
Mission.....	3, 6	6, 7
Objectives.....	4	6
Special staffs.....	7	8
Support plan.....	174, (app. IV)	82, 218
Army Medical Service aerial ambulance units.....	138-141	69

	Paragraph	Page
Artillery survey.....	132, 133	67
Audio means of communication.....	36-39	19
Availability, immediate.....	4d	6
Aviation:		
Annex to division SOP.....	(app. III)	214
Annex to operations order (<i>see also</i> Army Aviation support plan).....	(app. IV)	218
Aviation maintenance. (<i>See</i> Maintenance, aviation.)		
Aviation medicine:		
Definition.....	369	191
Duties and responsibilities.....	366-368	190
Medical and psychological aspects of flying.....	369	191
Medical officer training.....	365	190
Aviation supply. (<i>See</i> Supply, aviation.)		
Avionic equipment, technical characteristics of.....	(app. XIII)	249
Axis of signal communication (<i>see also</i> Reconnaissance, aerial)...	101	49
Battle drills (ACR units).....	57	31
Battlefield illumination.....	213	109
Biological and chemical agents, aviation use of.....	178d	89
Camouflage:		
Inspection (<i>see also</i> Observation, aerial).....	123-125	63
Of Army airfields.....	300	150
Painting of Army aircraft.....	194	99
Chemical and biological agents, aviation use of.....	178d	89
Column control.....	16-18	13
Of ground troops.....	18	14
Of ground vehicles.....	17	14
Combat:		
Intelligence. (<i>See</i> Intelligence, combat.)		
Reconnaissance, aerial (ACR) (<i>see also</i> Air mobility for land reconnaissance).....	54-57	30
Command:		
And liaison missions.....	12-15	12
Army aviators as liaison officers.....	14	12
Choice of aircraft for.....	15	12
Tactical use of.....	13	12
Assignment and employment of missions.....	6	7
Integrity of.....	4e	6
Responsibility.....	5, 11	7, 10
Communication, axis of signal (<i>see also</i> Reconnaissance, aerial)...	101	49
Communications:		
Air-to-air.....	280	140
Air-to-ground.....	279	138
Army aircraft equipment.....	275	133
Audio means of.....	36-39	19
Duties of unit communications officer.....	277	134
Ground-to-ground.....	278	135
Orders and instructions affecting.....	276	133
Security.....	281-284	140
Training (for aviation support missions).....	41	20
Continuous flow operation, support of.....	176a	84

	Paragraph	Page
Crash rescue and fire fighting:		
Crash rescue plan.....	362, 368	188, 191
Equipment.....	360	188
Organization of teams for.....	358	187
Personnel training scope for.....	359	187
Unit training.....	361	188
Cryptographic security.....	283	141
Decontamination of aircraft.....	192	97
Defense of aircraft:		
Altitude selection.....	202	103
Air defense weapons fire protection.....	197	100
Air warnings.....	196	100
Armor protection.....	195	100
Army aircraft protection.....	200	102
Artillery fire protection.....	198	101
Camouflage painting.....	194	99
Electronic countermeasures.....	203	103
Evasive maneuvers.....	201	102
Fighter aircraft protection.....	199	101
Defensive operations, employment in (<i>see also</i> Employment) ..	177-180	87
Depot maintenance.....	388	204
Desert operations.....	254-259	124
Distribution of force (in offensive operations).....	173	81
Electronic countermeasures.....	203	103
Employment:		
Concepts.....	150	75
Concepts of ACR.....	56	30
Factors.....	160-168	77
Allocation of aircraft.....	162	77
Decentralized execution.....	164	77
Maintenance.....	167	78
Planning.....	161	77
Terrain.....	168	78
Training.....	160	77
Utilization of aircraft.....	163	77
Vulnerability.....	165	78
Weather.....	166	78
Mission assignment and.....	6	7
Principles.....	151-159	75
Economy of force.....	156	76
Mass.....	155	76
Maneuver.....	157	76
Objective.....	151	75
Offensive.....	152	76
Security.....	159	77
Simplicity.....	153	76
Surprise.....	158	77
Unity of command.....	154	76
Tactical:		
In defensive operations.....	177-180	87
In offensive operations.....	172-176	80
In retrograde operations.....	181-183	93
Nuclear aspects of.....	184-192	94

Employment—Continued

Tactical—Continued	Paragraph	Page
Of fixed wing aircraft	170	79
Of rotary wing aircraft	171	80
Engineer reconnaissance (<i>see also</i> Reconnaissance, aerial)	99	49
Envelopment operation, support of	176b	85
Escape and evasion	345	178
Evacuation, aeromedical (<i>see also</i> Aeromedical evacuation)	136	69
Evasion and escape	345	178
Evasive maneuvers	201	102
Exploitation operation, support of	176c	87
External (helicopter) load operations:		
Aircrew procedures	(15, 16, app. XIX)	291, 292
Basic responsibilities	(4-6, app. XIX)	285
Crew techniques	(20-23, app. XIX)	297
Definitions	(3, app. XIX)	284
Equipment and data	(17-19, app. XIX)	292
Ground crew training	(10-14, app. XIX)	287
Operational sites	(7-9, app. XIX)	286
Preparation and rigging of loads	(24-69, app. XIX)	300
Standard cargo sling materials	(app. XIX)	284
Fallout:		
Aircrew contamination from	185b	94
Decontamination of aircraft	192	97
Maintenance crew contamination from	186b	95
Radiological survey plan	(app. VII)	235
Use of radiological survey	191, (apps. VII, VIII)	97, 235, 237
Field maintenance	387	202
Filming procedures	111, (app. VI)	55, 233
Fire, conduct of (<i>see also</i> Observation, aerial)	119-122	61
Fire plan, coordinated (in defense)	178b	88
Fire requests	(app. XII)	248
Fixed wing aircraft, employment of (<i>see also</i> Employment)	170	79
Flares, aircraft	213-216	109
Army aircraft capabilities for employment of	214	110
Battlefield illumination	213	109
Characteristics	213c (app. X)	110, 243
Disadvantages of	213b	110
Employment (sample request form)	(app. IX)	242
Loading and dispensing	216	111
Techniques for employment of	215	110
Uses of	213a	109
Flexibility, principle of	4b	6
Force, distribution of (in offensive operations)	173	81
Freedom of utilization, principle of	4c	6
Ground handling and mooring:		
Fixed wing aircraft	391	206
Hand signals and taxiing	396	209
Rotary wing aircraft	392	206
Servicing aircraft	395	207
Use of anchors and ropes in	393	207
Ground reconnaissance	294c, d	148

Guerilla operations:	Paragraph	Page
Army Aviation against.....	266-270	128
Army Aviation in support of.....	271-274	129
Hand signals.....	(app. XIV)	255
Hyperoxygenation.....	369a(2)	191
Hypoxia.....	369a(1)	191
Identification, aircraft (Indian names).....	(app. II)	213
Illumination, battlefield.....	213	109
Immediate availability.....	4d	6
Inspection, camouflage (<i>see also</i> Observation, aerial).....	123-125	63
Inspections, aircraft maintenance.....	389, 390	204, 205
Instrument approach factors.....	308, 309	153, 154
Integrity of command.....	4e	6
Intelligence:		
Combat.....	341-344	176
Capabilities.....	341	176
Counterintelligence.....	344	178
Functions.....	343	176
Division requirements (in offensive operations).....	175	83
Nuclear aspects of.....	189	96
Jungle operations.....	238-246	120
Liaison and command missions.....	12-15	12
Maintenance, aviation:		
Categories.....	383	199
Depot.....	388	204
Field.....	387	202
Inspections.....	389	204
Organizational.....	386	201
Principles.....	384	199
Responsibility of commanding officer.....	385	200
Map reconnaissance.....	294a	147
Mechanized penetration, support of.....	176b	85
Medical Service ambulance units, Army.....	138-141	69
Message drop and pickup.....	19-21	14
Equipment for.....	20	14
Methods (pole, modified pole, and throw)....	21, (1, 2, app. XVII)	15, 276
Pilot technique.....	(2e, app. XVII)	278
Scheduled service for.....	20	14
Signal man.....	(2d, app. XVII)	278
Unscheduled service for.....	20	14
Messenger and courier service.....	22-27	15
Advantages of rotary wing aircraft for.....	26	16
Security requirements.....	27	17
Types of.....	25	16
Mission, Army Aviation.....	3, 6	6, 7
Mission assignment and employment.....	6	7
Mobility of Army Aviation.....	4a	6
Navigation at night.....	209-211	106
Night operations:		
Advantages.....	205	105
Aerial photography during (<i>see also</i> Photography, aerial).....	217-219	111
Airfield requirements for.....	207	106
Battlefield illumination.....	213	109

Night operations—Continued	Paragraph	Page
Disadvantages.....	206	105
Flare illumination capabilities.....	214	110
Flight planning for.....	211	107
Loading and dispensing flares.....	216	111
Navigation during.....	209-211	106
Observation during (<i>see also</i> Surveillance, aerial).....	212-216	108
Orientation.....	210	107
Purpose of.....	204	105
Surveillance and adjustment of fire.....	212	108
Technique of flare employment.....	215	110
Night orientation.....	210	107
Nuclear aspects:		
Of employment (<i>see also</i> Employment).....	184-192	94
Air crew hazards.....	185	94
Control measures after explosion.....	190	97
Decontamination of aircraft.....	192	97
Effects on aircraft.....	187	95
Effects of troops.....	184	94
Maintenance crew hazards.....	186	95
Radiological survey.....	191	97
Reducing the effects of.....	188	96
Of combat intelligence.....	189	96
Observation, aerial (<i>see also</i> Night Operations):		
Altitudes for.....	82	42
Camouflage inspection by.....	123-125	63
Capabilities.....	77	39
Common errors in.....	80b	41
Conduct of fire.....	119-122	61
Army Aviation capabilities.....	119	61
Flight techniques.....	122	61
Locating the burst.....	121	61
Target offset.....	120	61
Determining direction in.....	83	42
Determining flight paths for.....	81	41
Indications of enemy activity.....	80a	40
Preflight planning for.....	79	39
Recording information.....	85	42
Reporting information.....	86	42
Tactical application of.....	76	39
Training for.....	87-92	44
Use in contaminated areas.....	78	39
Use of field glasses in.....	84	42
Occupation and organization of Army airfields.....	310-313	154
Offensive operations, employment in (<i>see also</i> Employment)....	172-176	80
Operations:		
Defensive (<i>see also</i> Employment).....	177-180	87
Night. (<i>See</i> Night operations.)		
Offensive (<i>see also</i> Employment).....	172-176	80
Retrograde.....	181	93
Special. (<i>See</i> Special operations.)		
Unilateral airlanded.....	45	23
Organizational maintenance.....	386	201

	Paragraph	Page
Panel codes, air-ground.....	(app. XI)	244
Parallel search pattern.....	355	185
Passive defense of Army airfields.....	324	166
Photographic and signal officer.....	106 <i>d</i>	52
Photography, aerial:		
Camera coverage and interval tables.....	(app. V)	220
Camera filters.....	(app. V)	220
Capabilities.....	105 <i>b</i>	51
Defensive considerations.....	110 <i>b</i>	54
Developing, printing and distribution (DPD).....	112	55
Filming procedures.....	111, (app. VI)	55, 233
Filter data.....	(2, app. V)	222
Formulas.....	(1, app. V)	220
Groundspeed conversion.....	(app. V)	220
G2 (S2) processing.....	108	53
Limitations.....	105 <i>c</i>	51
Mission.....	105 <i>a</i>	51
Mission planning.....	109	53
Mission requests.....	107	52
Night photography (<i>see also</i> Night operations).....	217-219	111
Planning scales.....	(app. V)	220
Preflight preparations.....	110	54
Scale charts.....	(app. V)	220
Staff responsibilities.....	106	51
Tactical use of.....	113	55
Utilized in camouflage inspection.....	125	64
Plan, Army Aviation support.....	173, 174, (app. IV)	81, 82, 218
Position defense, aviation support of.....	180	91
Position reconnaissance training.....	91 <i>d</i>	46
Propaganda dissemination.....	33-35	19
Execution technique.....	35	19
Planning factors in.....	34	19
Requests for.....	33	19
Pursuit operation, support of.....	176 <i>c</i>	87
Radio relay.....	30-32	18
Airborne stations.....	32	18
Ground stations.....	31	18
Radiological:		
Survey.....	134, 135, 191 (app. VIII)	68, 97, 237
Survey plan.....	(app. VII)	235
Reconnaissance, aerial combat (ACR) (<i>see also</i> Air mobility for land reconnaissance).....	54-57	30
Reconnaissance, aerial.....	93-104	46
Advantages.....	94	46
Cover for ground troops.....	96	47
Flight training.....	91	45
Limitations.....	95	47
Principles.....	93	46
Reports.....	104	51
Selection of radio relay sites by.....	102	50
Selection of wire routes by.....	103	50
Types of.....	97-100	48

	Paragraph	Page
Reconnaissance elements, air delivered (<i>see also</i> Air mobility for land reconnaissance)	58-75	31
Reconnaissance for airfield site selection:		
Air	294b	148
Combined map, air, and ground	294d	148
Ground	294c	148
Map	294a	147
References	(app. I)	210
Responsibilities, command	5	7
Resupply equipment and techniques	(app. XVI)	270
Bomb shackles	(2, app. XVI)	271
Flight characteristics of loaded aircraft	(7, app. XVI)	275
Lashing	(6, app. XVI)	274
Monorails	(4, app. XVI)	273
Parachutes and containers	(1, app. XVI)	270
Roller conveyers	(3, app. XVI)	271
Weights and positions of loads	(5, app. XVI)	273
Retrograde operations, employment in (<i>see also</i> Employment) ..	181	93
Rotary wing aircraft, employment of (<i>see also</i> Employment) ..	171	80
Route reconnaissance (<i>see also</i> Reconnaissance, aerial)	97	48
Training	91b	46
Seaplane facilities (<i>see also</i> Army airfields and landing areas) ..	314-319	157
Design and layout of shore-line area	317	159
Design and layout of water operating area	316	158
Lighting	319	161
Site selection for	315	157
Visual air marking	318	161
Search and rescue:		
Aircraft capabilities	348	180
Basic considerations	346	179
Conduct of	351	180
Methods	352-356	182
Procedures for initiating	350	180
Responsibilities	347	179
Types of missions	349	180
Security, communications	281-284	140
Signal:		
And photographic officer	106d	52
Communication, axis of (<i>see also</i> Reconnaissance, aerial) ..	101	49
Reconnaissance (<i>see also</i> Reconnaissance, aerial)	100	49
Signals, hand	(app. XIV)	255
Snow and extreme cold, operations in	260-265	126
Special operations:		
Adaptability of Army Aviation	221	114
Against guerilla forces	266-270	128
Airborne	222-229	114
Amphibious	230-237	118
Definition	220	114
Desert	254-259	124
In snow and extreme cold	260-265	126
In support of guerilla forces	271-274	129
Jungle	238-246	120
Mountain	247-253	123

Staff:	Paragraph	Page
Aviation special	7	8
Coordination	10	10
Duties	8	9
Estimates and recommendations	9	10
5-turn search pattern	361	188
Supplies:		
Rapid movement in combat zone. (See Airlift of equipment and supplies.)		
Training for aerial movement of	52, 53	28, 29
Supply, aviation:		
Aircraft out of commission parts (AOCP)	378	198
Channels	371	193
Classification of	372-374	195
Due-out release, DA Form 1544	382	198
Inventories	377	197
Issue and turn-in slip, DA Form 1546	381	198
Procedures	375	196
Reclamation and salvage	380	198
Return of serviceable items	379	198
Stock record account	376	197
Technical supply	370	193
Support plan, Army Aviation	173,	81, 82,
	174, (app. IV)	218
Surveillance, aerial:		
At night (see also Night operations)	212	108
Commander's use of	115	57
Definition	114	57
Mission planning	116a	57
Techniques	116	57
Transmission of reports	116c	58
Survey operations:		
Artillery	132, 133	67
Radiological (see also Radiological survey plan)	134, 135,	68, 97,
	191 (app. VIII)	237
Topographical	126-131	64
Tables:		
Aerial camera coverage and interval tables (vertical and oblique) 6-inch lens, 4½ x 4½-inch plate (table V)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 6½-inch lens, 4 x 5-inch plate (5-inch side longitudinal) (table VI)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 8-inch lens, 4¼ x 4½-inch plate (table VII)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 12-inch lens, 4½ x 4½-inch plate (table VIII)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 12-inch lens, 5 x 5-inch plate (table IX)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 12-inch lens, 9 x 9-inch plate (table X)	(app. V)	220
Aerial camera coverage and interval tables (vertical and oblique) 20-inch lens, 5 x 5-inch plate (table XI)	(app. V)	220
Aerial camera coverage and interval table (vertical and oblique) 24-inch lens, 4½ x 4½-inch plate (table XII) ..	(app. V)	220

Tables—Continued	Paragraph	Page
Approximate air-to-ground correlation factors for use when a direct determination cannot be made (table XIII) ..	(app. VIII)	237
Basic data for Army aircraft (table XXIII)	(app. XV)	261
Camera filters (table I)	(app. V)	220
Characteristics of aircraft flares (table XIV)	(app. X)	243
Communications equipment (table XVII)	(app. XIII)	249
Disassembly for air cargo shipment of fixed wing aircraft (table XXI)	(app. XV)	261
Disassembly for air cargo shipment of rotary wing aircraft (table XXII)	(app. XV)	261
Disassembly for motor and rail shipment of fixed wing aircraft (table XXV)	(app. XV)	261
Disassembly for rail and motor shipment of rotary wing aircraft (table XXVI)	(app. XV)	261
Groundspeed conversion (table II)	(app. V)	220
Highway clearance problems (table XXIV)	(app. XV)	261
Initial fire request elements (table XV)	(app. XII)	248
Joint communication-electronic nomenclature system (table XX)	(app. XIII)	249
Navigation equipment (table XVIII)	(app. XIII)	249
Photography planning scales (table III)	(app. V)	220
Scale charts (table IV)	(app. V)	220
Stabilization and compass systems (table XIX)	(app. XIII)	249
Standard cargo sling materials (table XXVII)	(app. XIX)	284
Subsequent fire request elements (table XVI)	(app. XII)	248
Target acquisition:		
Counterbattery technique	118	58
Technique	117	58
Target offset	120	61
Topographical survey	126-131	64
Training:		
For aerial combat reconnaissance (ACR) units	57	31
For aerial control of ground movement	42	21
For aerial movement of supplies	52, 53	28, 29
For aerial observers:		
Classification	87	44
For reconnaissance flights	91	45
In aerial adjustment of weapons fire	90	45
In aerial photography	92	46
In coordination with friendly air strikes	90b	45
Minimums	88	44
Requisites for nuclear fire evaluation	90c	45
Techniques	89	44
For aeromedical evacuation	148, 149	74
For air delivery of reconnaissance elements	73-75	38
For aviation support missions	40-42	20
For crash rescue teams	359, 361	187, 188
Management	328-333	169
Inspections	333	170
Instructor preparation	328	169
Procurement of equipment	329	169
Supervision	332	170
Training areas	331	170
Training time	330	169

	Paragraph	Page
Phases	334-340	171
Advanced individual	335	171
Concurrent	340	175
Field exercises and maneuvers	339	174
Objectives	338	173
Replacement	336	173
Unit	337	173
Responsibilities	325-327	168
Aviation staff officer	327	168
Unit commander	326	168
Transportation, aircraft	(app. XV)	261
Troop movement, airlift for	43-53	22
Unilateral airlanded operations	45	23
Utilization of Army Aviation, freedom of	4c	6
Visual air marking	318	161
Wire laying	28, 29, (app. XVIII)	17, 18, 280
Zone reconnaissance training	91c	46

By Order of *Wilber M. Brucker*, Secretary of the Army:

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USAR: Same as Active Army.

For explanation of abbreviations used, see AR 320-50.