Chapter 17

SEARCH PROCEDURES

17-1. General. Rescue missions often involve commitment based upon calculated risks and require maximum consideration of all safety factors. Timely reaction to all search missions is essential. Do not jeopardize safety of personnel or equipment by inadequate preparation or shortcuts to expedite takeoff or arrival at the search areas. Aircrews must comply with all applicable directives. This chapter extracts only a small amount of the information available. Refer to AFM 64-2 for more information.

a. The three positions of responsibility in a SAR mission are:

(1) SAR Mission Coordinator (SMC). Responsible for the overall prosecution of the SAR mission. The SMC selects forces, tasks missions, plans searches, directs recovery operations, and arranges for receiving survivors and providing medical care.

(2) On-Scene Commander (OSC). Responsible for the actions of all participants on-scene. The OSC makes status reports to the SMC, monitors weather, arranges for relief searchers, assigns individual search areas if so directed by the SMC, monitors Bingo fuel of the searchers, and performs any other tasks assigned by the SMC.

(3) Search and Recovery Vehicle (SRV). Searches assigned area at assigned track spacing, reports to the OSC, and does the recovery if the survivor is found or if directed by the OSC.

b. The rescue aircraft commander finding himself the first on-scene and the only person with any knowledge of a SAR incident has the responsibility of all three positions. The helicopter first on-scene should pass on OSC and SMC duties to someone with a greater capability to manage them as soon as practical. OSC duties belong to a fixed wing over a helicopter, a multi-engine airplane over a single engine and a ship over an airplane. SMC duties are normally handled by a Rescue Coordination Center.

17-2. Mission Planning. Mission planning begins at the first indications that a SAR mission exists. The mission commander determines appropriate procedures for search missions. The aircraft commander assumes this responsibility if the mission commander is not available at the start of the mission. Insure complete predeparture flight planning except for scramble missions. On scramble missions, essential flight planning may be completed prior to or shortly after takeoff.

a. Aircrew Briefings. Prior to launching a search mission, the entire crew requires a complete briefing. For urgent missions using scramble procedures, the duty controller briefs the AC while the crew prepares for the scramble. The AC will brief crew procedures and duties for the mission using the presearch checklist in chapter 31. Brief scanners on their duties (see paragraph 17-5) and brief sighting procedures (see paragraph 17-6). Proper mission planning and thorough aircrew briefings are inseparable.

b. An important aspect of mission planning is the gathering of information pertinent to the SAR objective. The following specific areas should be reviewed:

(1) Weather conditions.

(2) Terrain characteristics.

(3) Time of day.

(4) Signal aids available to survivor(s).

(5) Size, shape, color contrast, etc., of objects.

(6) Status of objective: overdue, lost, crashed, or ditched.

(7) Estimated location of objective. The most probable position of a distress incident may be determined by a fix, position report at the time of an incident, or dead reckoning estimate from the last known position of the craft in distress. Consider movement of the object such as parachute drift (see figure 17-1) or raft drift when establishing the search area.

(8) Determine the size of the area to be searched and plot it on your map.

(9) Fuel requirements. Determine Bingo fuel and consequently the amount of time available for the search. Include known contingencies for weather and recovery, and the required fuel reserve in your planning.

PARACHUTE DRIFT DISTANCE (ZERO GLIDE RATIO)

(Distance in miles of landing position downwind from position of parachute-opening)

Parachute-opening height	CLIMB WIND IN KNOTS 10	20	30	40	50	60	70
30,000 ft. (9,000m)	3.7	7.4	11.1	14.7	18.4	22.1	25.8
20,000 ft. (6,000m)	2.7	5.3	8.0	10.7	13.3	16.0	18.7
14,000 ft. (4,300m)	1.9	3.8	5.7	7.7	9.5	11.4	13.3
10,000 ft. (3,050m)	1.4	2.8	4.2	5.7	7.0	8.3	9.7
8,000 ft. (2,400m)	1.2	2.3	3.5	4.6	5.8	6.9	8.1
6,000 ft. (1,800m)	.9	1.7	2.6	3.5	4.4	5.2	6.1
4,000 ft. (1,200m)	.6	1.2	1.8	2.4	3.0	3.5	4.1
2,000 ft. (600m)	.3	.6	.9	1.2	1.5	1.8	2.1

Figure 17-1. Parachute Drift Distance.

c. Search Methods. The two basic methods of aerial search are visual and electronic.

(1) Use visual search as the primary method when visibility permits.

(2) Use electronic search when searching for survivors and space vehicles with transceivers/radio beacons. Monitor distress or preplanned beacon frequencies and home on the signal. Monitor applicable distress frequencies at all times while on search missions, except when making required transmissions.

NOTE: Civilian-used emergency locator transmitters (ELT) may broadcast on both 243.0 UHF and 121.5 VHF. Military emergency beacons broadcast only on 243.0 UHF.

d. Intensity of Coverage. The intensity of search coverage is determined by the size of the search area, number of search aircraft available, and the probability of finding the objective. Two types of search coverage are used—preliminary and concentrated:

(1) Preliminary search coverage is used during the initial phases of a mission, electronic searches, and during all night searches when NVG/HH-53H unique systems are not used. It permits rapid and reasonably thorough coverage of the primary area. Use this search if the search objective can be easily sighted or contacted. Use route, parallel, and/or creeping line search patterns with higher altitudes, faster airspeeds, and greater track spacing.

(2) Concentrated search coverage is used during the maximum effort phase of a mission or when attempting to locate a sighting or objective whose location is fairly well known. This type coverage insures a thorough search of the objective area. Use expanding square, rectangular, parallel, creeping line, or sector search patterns at low altitudes, slow airspeeds, and smaller track spacing.

e. Determine the search pattern. Select a search pattern suited to the situation. The search patterns listed below are provided as basic examples and may be modified as necessary. Refer to AFM 64-2 for additional patterns.

(1) Employ a route search when the only information available is a known or dead reckoning position or the intended track of the search objective. Employ a route search first, since it can be assumed that the objective is on or adjacent to its intended track, will be easily discernible or possesses electronic detection aids.

(2) Use a parallel search to cover large rectangular areas where the objective is expected to be between two points and possibly off track due to navigation error. It can be used simultaneously with or immediately after a route search. Navigational accuracy is increased by long search legs.

(3) If several aircraft are available, a creeping line version of the parallel search may be used in conjunction with or immediately after a route search. The creeping line search may be a substitute for an expanding square search during concentrated coverage when time is not a factor. It is more accurate and provides the same coverage.

(4) Use an expanding square search for concentrated search of a small area where a sighting or search objective has been reported.

(5) The expanding rectangle search may be substituted for an expanding square if error in the position is suspected or for moving or drifting objects.

(6) Use the sector search when the position of distress is known within close limits and the search area to be searched is not extensive. It provides greater navigational accuracy, increased scanning opportunity, and more flexibility than the expanding square.

(7) Use the contour search to search mountains or hilly terrain.

f. Track Spacing. Determine the track spacing that permits the best chance of objective detection and most economic use of search resources. Normally, use greater track spacing during preliminary search than during concentrated search.

(1) One method for determining track spacing is to divide the area to be searched by the product of TAS times the time available for search.

$$S = \frac{A}{TAX \times T}$$

Where S = track spacing, A = area, TAS = true airspeed, and T = time available for search.

This formula is particularly effective for preliminary searches or when time available for the search is a constraint. Additionally, this formula is helpful in selecting an optimum search speed.

(2) For concentrated searches, assuming adequate time is available to search the area, track spacing should not exceed twice the expected visual detection range. Use the detection ranges in figure 17-2 and crew judgment to determine detection range. For example, an individual in a life jacket is almost impossible to detect unless a signalling device is used; therefore, a detection range of one-fifth nautical mile should be used under this or similar circumstances.

g. Search Altitude. Base search altitude on the object of search, weather, location aids used, and any other known factors. Lower search altitudes afford a better chance of seeing an object. For preliminary searches, use higher altitudes to detect possible signals at greater distances. Use altitudes shown in figure 17-3 unless conditions preclude their use.

h. Search Speed:

(1) During preliminary searches, use recommended cruise speed computed from the flight manual. This allows the maximum area coverage for the least fuel.

(2) During concentrated searches, consider the time available to search the area in determining a search speed. Use of maximum endurance airspeed maximizes the time available, but a slower airspeed may be desired depending on the visibility, vegetation and size of the search object. The minimum airspeeds are: H-1, 50 KIAS; H-3/60A, 70 KIAS; H-53, 80 KIAS.

(3) During any search, make a power available check prior to slowing below safe single-engine airspeed. Avoid continuous flight at any altitude and airspeed when a safe autorotation or single-engine go-around cannot be made.

i. Other Search Vehicles. If other search vehicles are involved the OSC should coordinate search areas and altitudes. You must know the altitudes of search vehicles flying in adjacent search areas. With more than one aircraft involved in a search the knowledge of these aircraft location is important. Do not allow concentration on the search objective to interfere with clearing of turns or "see and avoid."

Equipment Item	Down Sun	Cross Sun	Up Sun	Overcast	Night
Yellow Life Raft (1- or 7-man)	1.9	1.4	1.1	1.0	---
Signaling mirror	6.3	7.0	4.8	---	---
Dye marker	3.8	2.5	2.2	---	---
Smoke	8.3	7.4	7.1	6.7	---
Life jacket	0.2	.18	.16	.15	---
Life jacket light	---	---	---	---	0.5
2-cell flashlight	---	---	---	---	2.4
Handheld star signal	---	---	---	---	32.0
Very cartridge	---	---	---	---	17.5

Figure 17-2. Visual Detection Ranges in Nautical Miles.

Over Water	
500 ft and below	Survivor without raft or dye marker
500 ft to 1000 ft	Survivor in raft without dye marker or signaling device
1000 ft to 2500 ft	If survivor has dye marker
1000 ft to 3000 ft	If survivor has signaling device/radar reflector
2000 ft to 3000 ft	When expecting to find wreckage during initial phase of the mission.
500 ft to 2000 ft	During night over water
Over Land	
1000 ft	Survivors of an aircraft incident over level terrain with little foliage
500 ft	Survivors of an aircraft incident over level terrain with heavy foliage
500 ft to 1000 ft	Survivors of an aircraft incident in mountainous terrain
2000 ft	When expecting to find wreckage
1000 ft to 2000 ft	Over land at night
Electronic Beacons	
8000 ft or higher	

Figure 17-3. Recommended Search Altitudes.

17-3. On-Scene Responsibilities:

a. Maintain vertical and horizontal separation of all aircraft in the search area. Helicopters are normally assigned the lower altitude in a joint search with fixed wing aircraft.

b. Operation normal (position) reports are usually transmitted each hour or as required by the controlling agency.

c. Compute Bingo time as soon as possible after takeoff and relay the information to the rescue coordination center and/or mission commander.

NOTE: The pilot flying the aircraft during a search mission will devote full attention to controlling the aircraft and maintaining terrain/obstacle clearance.

d. Report all deviations from planned search procedures to the on-scene commander or mission commander.

e. Thoroughly investigate sightings and report findings immediately. Have a marking device readily available to jettison. Initiate recovery action/assistance when the objectives are located. Keep appropriate agencies informed of progress.

f. The copilot will:

(1) Assist in doppler operation to determine wind drift corrections and ground speed.

(2) Assist in checking the timing to conform with planned search pattern.

(3) Plot the search pattern on an aeronautical chart.

(4) Relieve the pilot, as required.

(5) Record sighting information (time, location, and details of the sighting).

(6) Maintain radio communications as directed by the AC.

(7) Monitor altimeter during descent.

(8) Advise pilot when 100 feet above desired altitude.

(9) Monitor radar altimeter.

g. All crew members in the cargo compartment will assist as scanners. Scanners should be alternated periodically to prevent fatigue. The pilot flying the aircraft will devote full attention to flying the pattern and coordinating the crew's activities. The pilot not flying will monitor instruments and aircraft altitude and attitude.

17-4. Search Patterns. Selection of the search pattern is an important aspect of mission planning; however, if the search area involves unfamiliar terrain or conditions, selection of a search pattern should be made after a preliminary inflight survey of the area. There are several types of search patterns with numerous variations. These are creeping line, expanding square, and sector. Each has certain advantages and disadvantages which need to be considered when selecting the right search pattern to be flown. Figure 17-4 summarizes these characteristics. With the exception of the first pattern, all search patterns are designed for visual search, but can be used for electronic search as well. While conducting any search, if possible, use a combination of visual and electronic sensors.

a. Narrowing Search Area—"Boxing-In" Technique (figure 17-5):

(1) In this procedure the aircraft flies a "boxing-in" pattern on the assumption that the area of equal beacon signal strength is circular. If homing equipment is inoperative and the objective is not at the last known position, this technique is very valuable. The position of the aircraft is plotted by the crew as soon as the objective beacon/radio signal is heard for the first time. The pilot continues on the same heading for a short distance, then turns 90° either left or right and proceeds until the signal fades. This position also is noted and plotted. Now the pilot turns 180° (either direction) and once again the positions where the signal is heard and where it fades are noted. The approximate position of the beacon can now be found:

(a) Draw lines between each set of "signal heard" and "signal fade" positions.

(b) Next, draw perpendicular lines at the center of the connecting lines drawn in Step 1. There will be three such lines.

(c) Where the three perpendicular lines intersect is the appropriate position of the beacon/radio.

(2) Since the area of equal signal strength on which this procedure is based is seldom circular, the triangular area produced by the perpendicular lines will give only an approximate position. The triangular area thus is the area where a concentrated search must be made using conventional techniques.

NOTE: For aircraft equipped with radios having two antennas, additional directional information may be obtained by switching antennas to find out which receives the strongest signal. The radio source is in the general direction of that antenna.

Search Pattern	Advantages	Disadvantages
Expanding Square	Starts at datum Easy nav	Many turns Turns in middle No nav update
Sector Search	Concentrates on datum Easy nav after start Nav DR only Many nav updates	Undersearches outside Difficult to set up Follow-on search difficult
Creeping Line Search	Easy nav Versatile Long, straight legs Follow-on Search easy	Starts at corner Only one nav update

Figure 17-4. Search Pattern Characteristics.

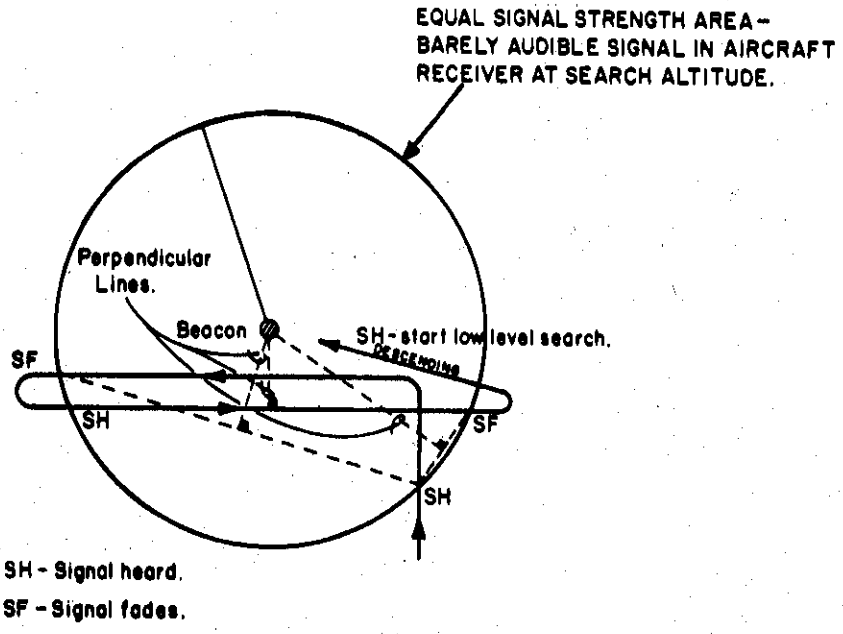


Figure 17-5. Narrowing Search Area—"Boxing-In" Technique.

b. Creeping Line Patterns. To assist in planning the turns to roll out on track, figure 17-6 shows the relationship between TAS and turn radius. Additional techniques and search pattern information can be found in AFM 64-2, chapter 9.

(1) Route Search:

(a) Route search consists of one search leg along a given track.

(b) Start the search leg at the point nearest the search aircraft's departure base and search along the proposed route of the missing objective between the last known position (LKP) and the intended destination. If the LKP is the last position report received from the mission objective, search between the LKP and the point where the next report was due. Extend the track 25 nautical miles to allow for navigation error on the part of the mission aircraft.

(2) Parallel Search (Figure 17-7):

(a) The parallel search is a series of parallel legs (tracks) advancing from one side of an area to the other. The longer search legs parallel the objective's intended track or the long side of a rectangular search area. The short legs (cross leg) of a parallel search are the computed track spacing.

(b) The parallel search may be used to cover the area on each side of the search objective's intended track. Begin the parallel search at one end of the route. Search and advance the pattern away from the objective's intended track. Allow for navigational error or drift of the new search objective.

(3) Creeping Line Search (Figure 17-8). The creeping line search is a series of parallel tracks advancing along a given axis. The longer legs are perpendicular to the creep axis and are sufficient in length to cover the search objective area. The cross legs of a creeping line search are the computed track spacing.

(4) Multiple and Coordinated Creeping Line Searches (Figure 17-9). The creeping line pattern may be modified to provide mutual navigation assistance between multiple SRVs. Pre-planning is essential to ensure safety, accurate search and coordinated effort. Any combination of patterns is acceptable, as long as the search objectives of area and track spacing are met.

(a) The contour search is used to search mountainous or hilly terrain. The search legs may be flown around a peak or back and forth along the side of the mountain, depending upon the size and accessibility of the area to be searched.

Airspeed	DISTANCE S/R	1/2S/R	Airspeed	DISTANCE S/R	1/2S/R
60	.7	1.3	110	1.2	2.3
70	.8	1.5	120	1.3	2.6
80	.9	1.7	130	1.4	2.8
90	1.0	1.9	140	1.5	3.0
100	1.1	2.1	150	1.6	3.2

Figure 17-6. Distance Traveled Perpendicular to Track in 180 Degree Standard (S/R) and Half Standard Rate (½S/R) Turn.

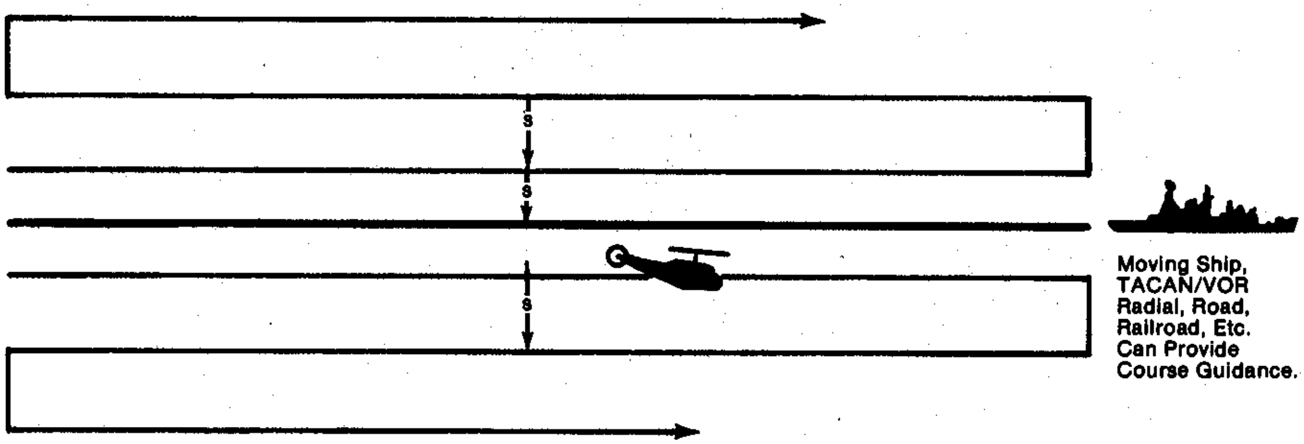


Figure 17-7. Parallel Search Pattern.

(b) Start searching above the highest peak or ridge and search from top to bottom. Descend at the end of each leg. Use extreme care during the search. Do not fly this type of search when terrain conditions, high winds, turbulence, visibility, or other weather conditions create a hazard to safe flight. Monitor and evaluate these conditions constantly throughout the search. The pilot flying the aircraft must devote full attention to evaluating terrain for clearance and hazards to flight. All other crew members should aid in clearing power lines, cables, etc. Exercise extreme caution when searching in canyons and valleys. Assure adequate clearance before entering the area. Always maintain an "out." Plan ahead and know which way to turn in the event of an emergency.

c. Expanding Square Search (Figure 17-11):

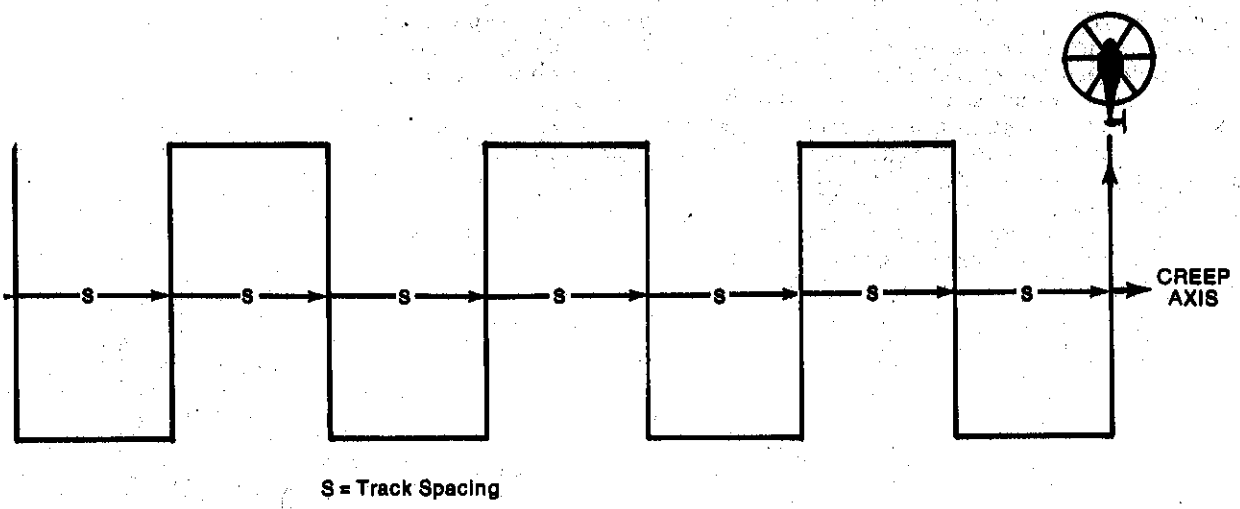
(1) The expanding square search is a series of right angle search legs which expand outward forming a square pattern. The first and second legs are equal in length to track spacing and each two succeeding legs are increased in length by the computed track spacing.

(2) Begin the search at the center point of the area of highest probability. Limit this pattern to cover an area no larger than 20 nautical miles square. To minimize navigational error, plan upwind/downwind and crosswind legs. Use cardinal headings if wind is negligible or time does not permit detailed pre-planning. If doppler is available, use cardinal true track for headings, and position counters to determine navigational turn points and track information.

(3) The pattern is easily modified to give an expanding rectangle pattern, if required.

d. Sector Search (Figures 17-12 through 17-16):

(1) The sector search is a series of legs which radiate from a datum point (center of most probable position). Each long leg is equal to the diameter of the



NOTE: In other than no-wind conditions, drift and ground speed corrections are necessary to accurately fly this pattern. Use doppler if available.

Figure 17-8. Creeping Line Search Pattern.

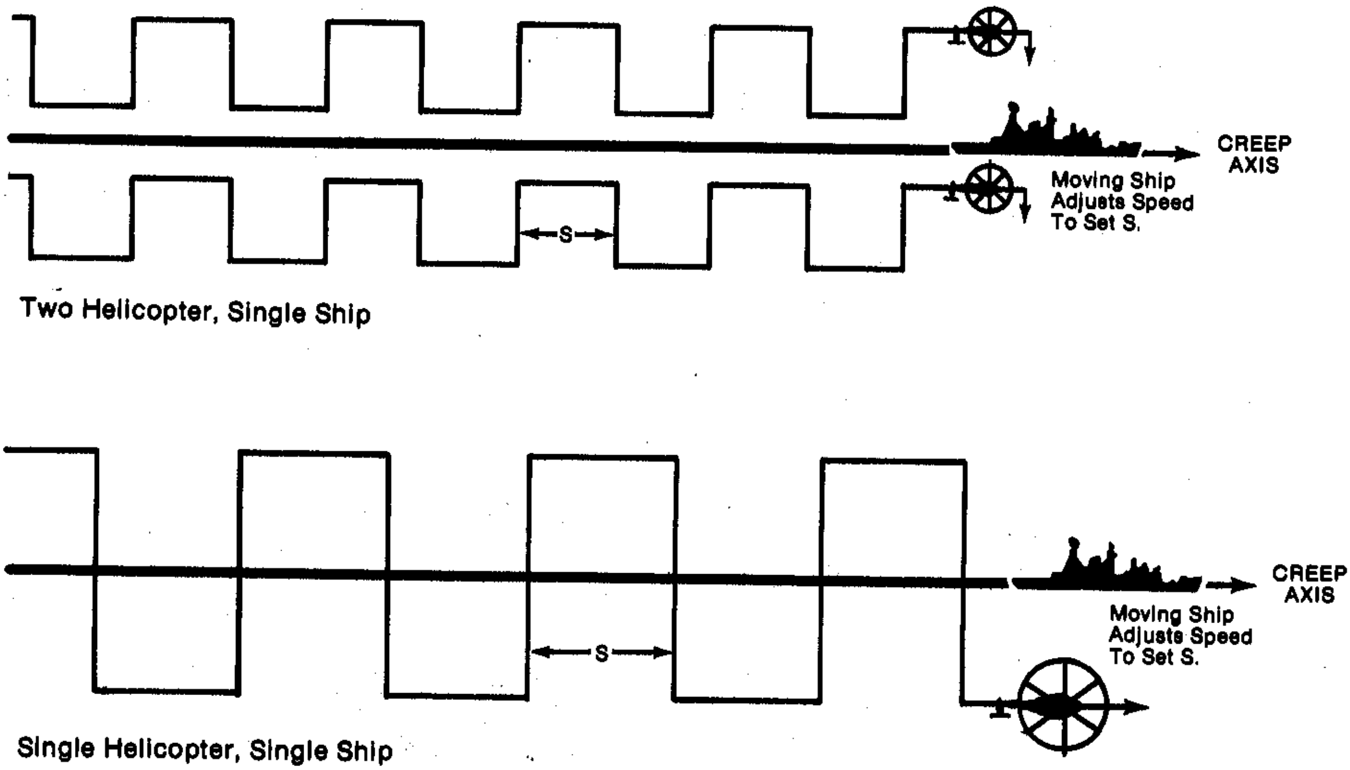


Figure 17-9. Multiple, Coordinated Creeping Line Patterns.

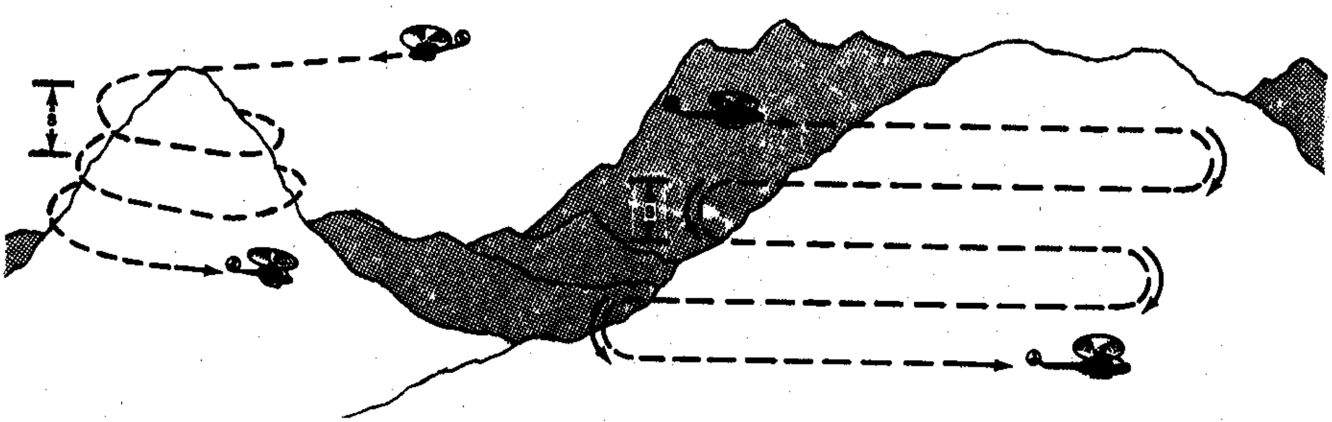
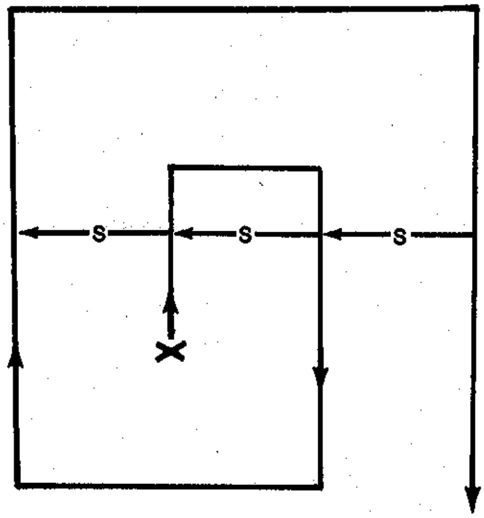


Figure 17-10. Contour Search Patterns.



NOTE: In other than no-wind conditions, drift and ground speed corrections are necessary to accurately fly this pattern. Use doppler if available.

Figure 17-11. Expanding Square Search Pattern.

SEARCH RADIUS	2		4		6		8		12	
	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME
5	12	1.2	24	0.6						
10	6	4.4	12	2.4	18	1.6	24	1.2	36	1.0

NOTES

1. Ground speed of 75 knots used to compute time.
2. Time = hours required to complete one 360 degree pattern.
3. Degree = degrees to add to 90°.
4. Distances in NM.

Figure 17-12. Sector Search Track Spacing (S)—75 Kt.

SEARCH RADIUS	2		4		6		8		12	
	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME	DEGREES	TIME
5	12	0.8	24	0.5						
10	6	3.0	12	1.6	13	1.2	24	0.8	36	0.6

NOTES

1. Ground speed of 120 knots used to compute time.
2. Time = hours required to complete one 360 degree pattern.
3. Degree = degrees to add to 90°.
4. Distances in NM.

Figure 17-13. Sector Search Track Spacig (S)—120 Kt.

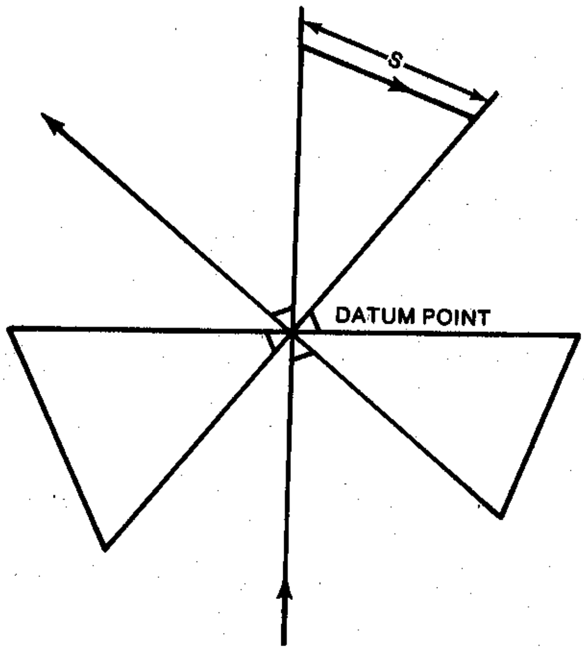


Figure 17-14. Typical Sector Search (8 Sections).

area where the objective is most likely to be found and the cross legs are equal to computed track spacing.

(2) Begin search at the datum point. Drop smoke signals or other suitable reference markers at the datum point as a reference for precise search legs. When planning the search, align the first leg with the search objective's most probable direction of movement or drift. If the movements or drift are not determining factor, start on the heading inbound to the datum point.

(3) Remark the datum point periodically for continuous reference.

(4) The heading of each leg is found by adding the course change angle to the last heading.

(5) Make all turns to the right for a clockwise search.

(6) The primary search method is visual.

(7) A sector search pattern which is especially easy to fly is the 6 sector pattern. If two patterns are flown, offset by 30°, a series of overlapping equilateral triangles results (figure 17-15). This pattern is appropriate where the search radius is relatively small and accuracy of navigation equipment is in doubt. All heading changes are 120 degrees.

17-5. Scanning Techniques. Precise scanning is the heart of a search. Crew members in the cargo compartment are the primary scanners.

a. Use a routine scanning pattern. The eyes should move and pause each three or four degrees to cover 10 degrees in approximately 10 seconds. Start scan at a distance and work back toward the aircraft. Avoid turning away from the scanning pattern, closing your eyes, or focusing short of the scanning area.

b. Scanning is tiring and requires periodic rest. With two scanners available, limit scanning to 30 minutes and alternate from one side of the aircraft to the other. With three scanners, switch positions each 30 minutes, i.e., left side, right side, rest.

c. Telltale signs to look for:

(1) Water Searches: Oil slicks, debris, wakes, life boats, rafts. Debris is normally found downwind of oil slicks and rafts/boats downwind of debris.

(2) Land Searches: Smoke, broken or scarred trees, shiny metal, fires, freshly burned out areas, parachutes, signals.

17-6. Sighting Procedures:

a. When a sighting is made, notify the rest of the crew using the clock system and estimated distance to indicate the position of the sighting.

b. Immediately upon making a sighting, drop a smoke signal or sea dye to mark the approximate location of the sighting. This marker will assist in returning to the search pattern if the sighting was false. If the sighting is lost prior to confirmation, a return to the marker can assist in reacquiring the objective. Use caution when dropping a smoke device over a wooded area to prevent forest fire.

c. If the observer can keep the objective in sight, turn in the direction of the objective. The scanner will continue to call out the target position and distance for orientation. As the turn progresses, the pilot or copilot should be able to see the target. If in a joint search with an HC-130 aircraft, respond to HC-130 requests. The HC-130 will direct the helicopter to the sighting location as soon as the objective has been identified or if assistance is needed in identifying a sighting.

d. Confirmed sighting procedures:

(1) Keep the target in sight at all times.

(2) Mark with seadye marker/smokes (when applicable).

(3) Report the sighting to the on-scene commander.

(4) When the sighting has been investigated, report the results to the OSC. A false sighting involving objects related to the search is important to the OSC as it can give indications of drift in the area.

(5) If the sighting is positive, report the position, number and condition of survivors and actions in progress to effect recovery. Do not hesitate to request assistance, if required.

17-7. Wind and Sea State Determinations. The doppler may be the best source of determining wind direction. Over a land mass, available smoke and smoke markers provide wind information. Over water, the crestlines of waves are perpendicular to the direction of the wind. Ripples and waves break away from the wind (downwind). The foam of the whitecaps formed by breaking waves always appears to slide into the wind (upwind). There may be streaks in the water parallel to the wind direction. Wave heights may be estimated using figure 17-16.

a. Normally, at 500 feet over large bodies of water, the wind will be the same as on the surface of the sea. However, with very rough seas, surface friction tends to slow down the wind.

b. As a rule of thumb, wind direction increases by 10° per 1000' with increases in altitude, up to 3000' in the northern hemisphere. Velocity will also vary with increases in altitude.

LEG	HEADING (1)	DIST	TURN
1	360	1	120
2	120	1	120
3	240	2	120
4	360	1	120
5	120	2	120
6	240	1	120
7	360	1	30 (2)
8	030	1	120
9	150	1	120
10	270	2	120
11	030	1	120
12	150	2	120
13	270	1	120
14	030	1	---

(1) DISTANCE MAY BE USED AS A FACTOR AND HALVED/MULTIPLIED FOR DESIRED LENGTHS.

(2) A SECOND PATTERN MAY BE FLOWN IF REQUIRED. SHIFT THE PATTERN 30 DEGREES TO THE RIGHT.

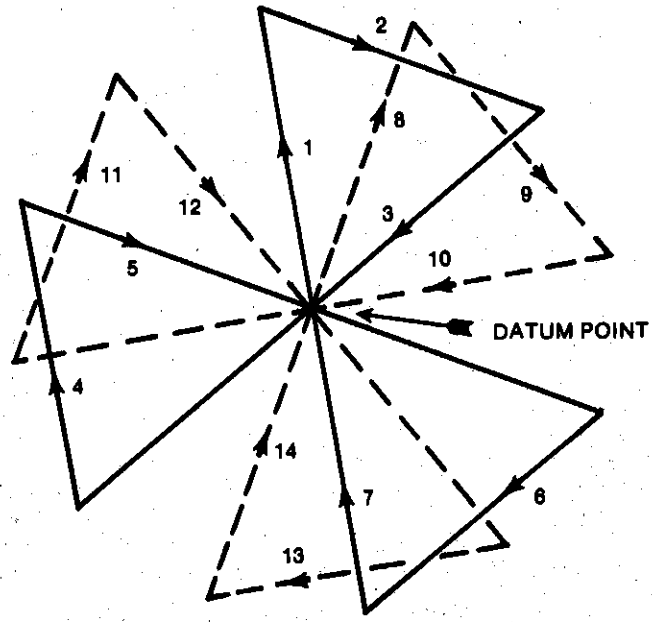


Figure 17-15. Alternate Sector Search Pattern (Equilateral Triangles).

WIND		SEA	
BEAUFORT SCALE	VELOCITY (KNOTS)	DESCRIPTION	WAVE HEIGHT (FEET)
0 (CALM)	UP TO 1	Sea like mirror	0
1 (LIGHT AIR)	1-3	Ripples with the appearance of scales are formed, but without foam crests.	.1
2 (LIGHT BREEZE)	4-7	Small wavelets, still short but more pronounced; crests have glassy appearance but do not break.	.3
3 (GENTLE BREEZE)	8-12	Large wavelets, crests begin to break. Foam of glossy appearance. Perhaps scattered white horses.	1.2
4 (MODERATE BREEZE)	13-18	Small waves, becoming larger; fairly frequent white horses.	2-5
5 (FRESH BREEZE)	19-24	Moderate waves, taking more pronounced long foam; many white horses are formed. (Chance of some spray)	6-8

Figure 17-16. Wind & Seas (Beaufort Scale).

SAR ON-SCENE PROCEDURES

1. RESPONSIBILITY. Commanders will insure that all personnel are completely familiar with this tab. Ascertain what laws and regulations govern the removal of remains within their area of operation and provide this information to all personnel. Establish the necessary liaison with military and civil authorities to insure a coordinated, professional effort whenever 23 AF personnel become involved in the removal of human remains.

2. SURVIVOR'S REPORT. Report survivors' conditions, without mentioning names. State condition of the objective, if applicable, to on-scene aircraft commander.

3. HUMAN REMAINS. Twenty-Third AF does not normally remove human remains from crash or incident sites. However, factors such as the remote or inaccessible areas, weather conditions, darkness, or the like, may prompt a request from appropriate authorities for removal of remains. Except as provided in subparagraph c, below, do not commit 23 AF resources to body removal until the mission approving/releasing authority has been informed of the request and the attendant circumstances, and has authorized the removal of the remains. The mission approving/releasing authority is responsible for the safety of 23 AF resources and should not jeopardize them for body recovery. Except as provided in subparagraph c, below, the mission approving/releasing authority is responsible for compliance with any laws or regulations concerning the transport of human remains.

a. Military Personnel. If the crash or incident site is on a military reservation or within military jurisdiction, the remains of military personnel shall be removed only with the approval of a medical officer. In the absence of a medical officer at the crash or incident site, approval must be obtained from the proper military medical authority prior to removal of remains. If the crash or incident site is not within military control, jurisdiction over the remains rests with the civil authorities. In such cases, do not remove remains unless authorized by the appropriate civil official (usually the local coroner or medical examiner).

b. Civilian Personnel. The remains of civilian personnel employed by the military are recovered as in subparagraph a, above. Remains of other civilians may be removed IAW applicable laws of the jurisdiction, after authority has been obtained.

c. Exceptional Cases. In extreme situations where time is critical and communications are impossible, the aircraft commander may, with the approval of the appropriate civil official, remove remains and deliver them to the proper civil authorities. This procedure is authorized only if conditions already make it impossible to obtain timely approval from the mission approving/releasing authority. Whenever this procedure is employed, the aircraft commander must comply with any laws or regulations affecting the transport of human remains.

d. Civil Appointments. 23 AF personnel will not, at any time, accept appointments as deputy coroner.

e. International Aspects. A mission requiring the removal of human remains, military or civilian, across international borders will involve national as well as local law. Prior to such operations, consult the United Stated diplomatic officials to the concerned countries, to obtain necessary clearance(s) for the operation.

4. SAFEGUARDING AIRCRAFT WRECKAGE (reference AFR 127-4). If they are the first on the scene, pararescue teams will establish guards until properly relieved. Guard classified matter until competent authority assumes control. Do not disturb personal effects on survivors or deceased. Personal effects found in the crash area will be inventoried and stored. Obtain receipts from personnel who assume custody, and retain them with inventories in the unit.

5. PERMISSION TO ENTER PRIVATE PROPERTY. Obtain written permission from the owner or person in control prior to entering private property.

6. MARKING AIRCRAFT WRECKAGE. Obliterating or marking abandoned USAF aircraft wreckage is the responsibility of base commanders (reference AFR 137-4). However, this function may be delegated to a CAP or 23 AF unit. Use the following procedures:

a. USAF Aircraft. Mark wreckage with a yellow cross as large as the condition of the wreckage permits. When condition of wreckage prevents a marking easily visible form the air, appropriately mark logs, rocks, and other material in the immediate area.

b. Non-USAF Wreckage. Do not mark or obliterate non-USAF aircraft to guard against possible damage claims against USAF. Paint a yellow cross on material other than aircraft parts.

c. Recording Data on Wreckage. To assist aircraft accident investigations, the pararescue team will prepare a written description of the aircraft remnants and their location; the location, attire, and appearance of victims and survivors; evidence of accident cause, including instrument readings, control settings, condition and attitudes of control surfaces and landing gear; and such other data that may assist in analyzing the accident. Make every effort to preserve all aircraft papers, including flight records, charts, maintenance forms, radio logs, etc.

7. IFF. MAC aircraft are authorized to use Mode 3, Code 1277, when operating in domestic airspace when on a VFR flight plan or on the VFR segment of a composite IFR/VFR flight plan, and:

a. On an official SAR mission.

b. En route to/from or within a designated search area.

Chapter 18

CARGO SLING OPERATIONS

18-1. General. It is not practical or necessary to publish separate aircrew procedures for every possible sling load that helicopters may be tasked to carry. Problems regarding sling loads primarily involve improper preparation of the load. If the load is configured correctly, the procedures are the same whatever the load may be. The aircraft commander is responsible for selection of the hookup and release point. Coordination with the unit requesting the airlift and the unit furnishing support may be necessary. The hookup and release areas should be selected to avoid flight over people, vehicles, buildings, or congested areas and to provide optimum safety. The surface must be relatively level and free of vertical obstructions. Areas of dust, mud, snow, or ice should be avoided. Mark the hookup and release point for easy identification. Determine wind direction and estimated velocity prior to conducting cargo sling operations; however, to allow for a margin of safety, wind is not considered in computations for power required to hover. Preposition loads to expedite hookup. Thoroughly brief all personnel concerned with the mission on their duties and responsibilities during the operation. Give particular attention to the increased rotor downwash and its effect on loose equipment, personnel, and debris.

18-2. Sling Procedures. Prior to cargo sling/hook operations, thoroughly preflight all cargo sling/hook components. The automatic release feature of the H-3 and H-53 cargo hook will not be used under normal operations. However, if use of the automatic mode is warranted, it will be checked by hooking up the load and placing tension on the cargo sling. With tension on the sling, move the sling master switch from the "sling" to the "auto" position. If the hook releases, do not use the automatic mode and document the discrepancy in the AFTO Form 781A. Cargo sling operations using the Shepard's look will be conducted using the procedures contained in the appropriate flight manual.

a. Cargo Pickup. Hookup to the cargo load is accomplished using interphone instructions between the flight engineer and the pilot, and when required, hand signals between flight engineer and hookup person. The hookup person should be a qualified aircrew member. Brief the hook up person on hookup procedures to include: hook grounding, ingress/egress routes, hand signals, and emergency procedures.

(1) Accomplish an inflight power available check prior to sling operations. Compare computed power required to lift the load with power available to insure an adequate margin is available. For H-3/53 sling operations use maximum RPM for hookup, takeoff and approach.

(2) Hookups may be accomplished by landing near the load or hovering over the load depending on the availability of personnel to perform hookup duties.

(a) When landing next to the load, hover or ground taxi the helicopter into a position near the load and place the collective at flat pitch. Maintain adequate rotor/aircraft clearance with the load. Route the lift strap/cable around the landing gear/skid allowing sufficient slack so that it will not be taunt when the helicopter is raised to a hover. The FE will monitor the lift strap/cable during the takeoff to a hover and direct the helicopter to a position over the load.

(b) When securing the load from a hover, hover the helicopter into the wind and position it over the load. The pilot can best control the approach until the pickup point can no longer be observed. When the pilot can no longer observe the load, the FE directs the pilot to a position to accomplish the hookup. As soon as the load is securely attached to the cargo hook, the hookup person will clear the area directly beneath the helicopter and the FE will notify the pilot the load is ready to lift. Ensure sufficient power is available to takeoff by slowly increase collective pitch to take up any slack in the sling and center the helicopter over the load. When operating in sandy or dusty conditions, avoid abrupt power changes in order to minimize the possibility of reduced visibility. Objects which take on water should be allowed to drain while the helicopter is in hover prior to takeoff. During takeoff and climb out, the FE informs the pilot of the towing characteristics being encountered. If the load begins to develop undesirable or abnormal aerodynamic characteristics, reduce forward speed to a point where the load is stable and continue the mission. If the airspeed to stabilize a load is too slow, it may be necessary to return to the pickup point and secure spoilers or reconfigure the load. Spoilers may be drag chutes, sandbags, or other material which distort the airflow.

(3) Normally, turn the sling arming switch off at altitudes above 500 feet AGL and turn it on below 500 feet AGL.

(4) The radar altimeter when installed can be of great value during sling operations. Over level terrain with a 40 foot sling, set the radar altimeter pointer on 50 feet and use that altitude as a level-off point until the FE in the cabin has sight of the load. During pickups where the ground personnel attach the sling to the helicopter, a radar altimeter setting of 20 feet is a good minimum until the hover is established and the pilot starts receiving directions (use of the radar altimeter is optional).

b. In-flight. Each sling load is different. Limit forward flight to an airspeed commensurate with the aerodynamic stability of the load.

(1) Avoid flying over personnel, buildings, or equipment.

(2) Flight with a sling load in turbulent air can result in severe oscillations and possible loss of aircraft control. Avoid areas of known or suspected turbulence.

(3) Any time load oscillations cannot be controlled, and increase to a point where loss of aircraft control is imminent, jettison the load.

c. Delivery. Closely monitor power requirements and anticipate power changes. The key to successful sling approaches is smooth and positive aircraft control. Take care to prevent dragging the load on the ground. Normally, hover with the load approximately six to eight feet above the ground. A vertical descent is then made to place the load on the surface at which time it is released. Certain sling loads can cause the radar altimeter to give an erroneous reading throughout the flight. When load interference is not a factor, the radar altimeter set pointer should set at a value equal to the sling length + load height + 10 feet. This provides adequate ground clearance upon load delivery.

d. Interphone Procedures. Use the term "load hooked" for completion of hookup and "load released" when cargo is unhooked to inform the pilot of the cargo condition. The FE provides additional information including cargo ground clearance during approach or hover and the condition of cargo in flight.

18-3. Safety Procedures. The following procedures will apply to all cargo sling missions:

a. Position the hookup person at the load to effect an immediate hookup. After the hookup, the hookup person egresses at the two to three o'clock position. Egress can be made at the 10 to 11 o'clock position if necessary. Turn the H-53 cargo hook arming switch "ON" when the pilot can see that the hookup person is clear of the aircraft.

b. The hookup person must wear goggles for eye protection. A helmet should be worn if available.

c. Check all cargo sling releases and lift straps/cables for proper operation/condition prior to picking up a sling load.

d. Move all cargo sling loads slightly before pickup to insure that they are not frozen or otherwise held fast to the surface.

e. Recommend the lower strobe light be turned off during pickup and delivery. Other lights should be turned off and retracted if they could distract the hookup person or interfere with the hookup.

18-4. Emergency Procedures. It is not practical or necessary to publish all emergency situations that could occur during cargo sling operations. Good training habits and sound judgment by all concerned should eliminate problems when emergencies do occur. The following guidance is given:

a. When using ground hookup personnel:

(1) If, prior to hookup, complete loss of power occurs, execute a hovering autorotation to the left of the load. Hold sufficient pitch and left cyclic after autorotation is entered to clear the load. Once clear of the load, execute a normal hovering autorotation (if required).

(2) After hookup, should engine failure or loss of power occur over the load, make every attempt to release the load and execute a hovering autorotation (if required) to the left of the load.

(3) If engine failure or loss of power occurs, the ground crew should consider the following:

(a) All ground personnel will brief intended actions with the aircrew.

(b) Marshaller. Turn away from the aircraft and lie face down on the ground, covering head with both arms to protect from flying objects, should the aircraft crash.

(c) Hookup Person. Take action pre-briefed with the crew, i.e., hug the load, dive clear to the right, etc.

(4) If an inflight emergency is encountered, external loads should be jettisoned when/if necessary.

b. When using the cargo hook loading pole (Shepherd's Hook). If power is lost while hovering above the load, immediately jettison the load (if necessary) and clear the load to the side which provides the best obstacle clearance/landing surface. Normally, clear the load to the side of the pilot flying. Once clear, execute a normal hovering autorotation/single-engine landing.

18-5. External Transport of Aircraft. External transportation of aircraft requires the utmost coordination between the flight and ground crews. An aircraft recovery kit contains all equipment necessary for conducting the mission (refer to TO 00-80C-3 for proper procedures).

18-6. F-111 Crew Module Recovery. Any helicopter capable of lifting and transporting a weight of 2,500 pounds can recover the F-111 crew module (minus crew). The only approved method of transporting the module is by its structural member. Deploy a ground crew to prepare the module for retrieval. If other than qualified personnel have accomplished the preparation, a trained helicopter crewmember will inspect the configuration to insure it meets the requirements outlined in the following procedures. Do not hover over the module until all explosive devices are safetied and all parachutes are removed.

a. Module Preparation. Ground crew personnel will:

(1) Insure explosive devices are safetied. Upon activation of armed switches inside the module, metal covers are propelled in random directions up to 100 feet. Location of explosive hazard areas are shown in figure 18-1. Dearming procedures are contained in TO 00-105E-9.

(2) Insure that main parachute is removed from module, if the main parachute has not been jettisoned. Cut risers at point "A" as shown in figure 18-1. Stow the parachute to prevent the helicopter from blowing it.

(3) Cut the stabilization brake chute bridle. If the module is inverted and the structure member is inaccessible, the module can be righted by utilizing the stabilization brake chute bridle. This requires attachment of the cargo sling hook to the apex of the bridle lifting the module and then setting it down right side up. Prior to lifting module, insure that all parachutes are detached.

(4) Secure a lifting chain around the structural member as shown in figure 18-2. The lifting chain must be rated at 10,000 pounds minimum, with a positive locking device. Due to the small clearance under the module's structural member (two inches on most F-111 module models), the chain should have a maximum diameter of one and one-half inches. Do not use lifting straps or cables due to sharp edges of the structural member. If a cargo tie-down chain is used, secure the free portion of chain with tape to prevent inadvertent disconnect.

(5) Insure both hatches are closed and secure.

(6) Puncture all inflated bags close to the bottom of each, using a fixed blade knife. On water recoveries, the deflation of the flotation bags will not sink a sealed module. If large quantities of water are present in the module, exercise caution during lifting due to the unknown weight condition.

b. Module pickup and transport. Use a 20-foot swivel sling rated at 10,000 pounds or above. A sling shorter than 20 feet will not be used. Observe the following limits: 80 KIAS, 500 FPM climb, 1,000 FPM descent, and 20 degrees angle of bank.

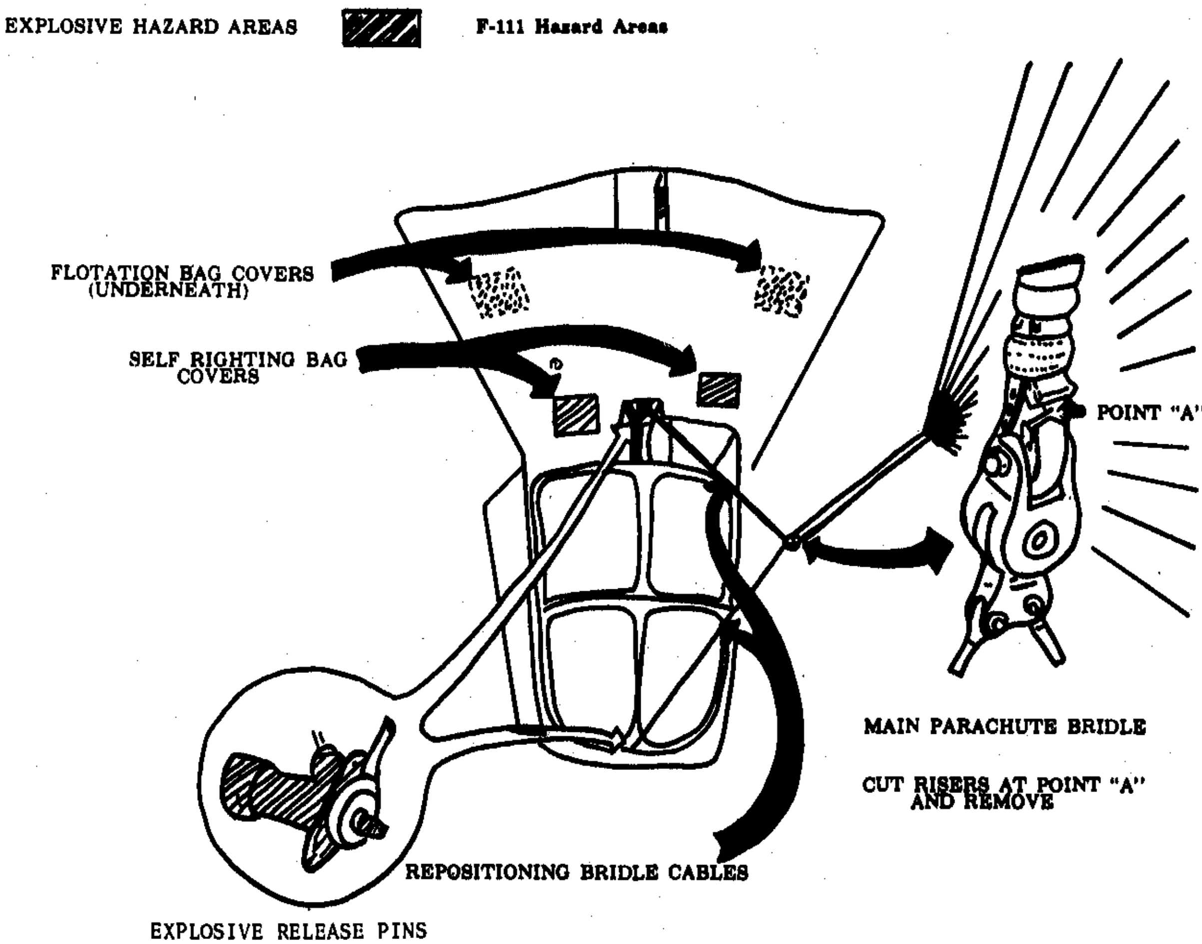


Figure 18-1. F-111 Module Explosive Hazard Areas.

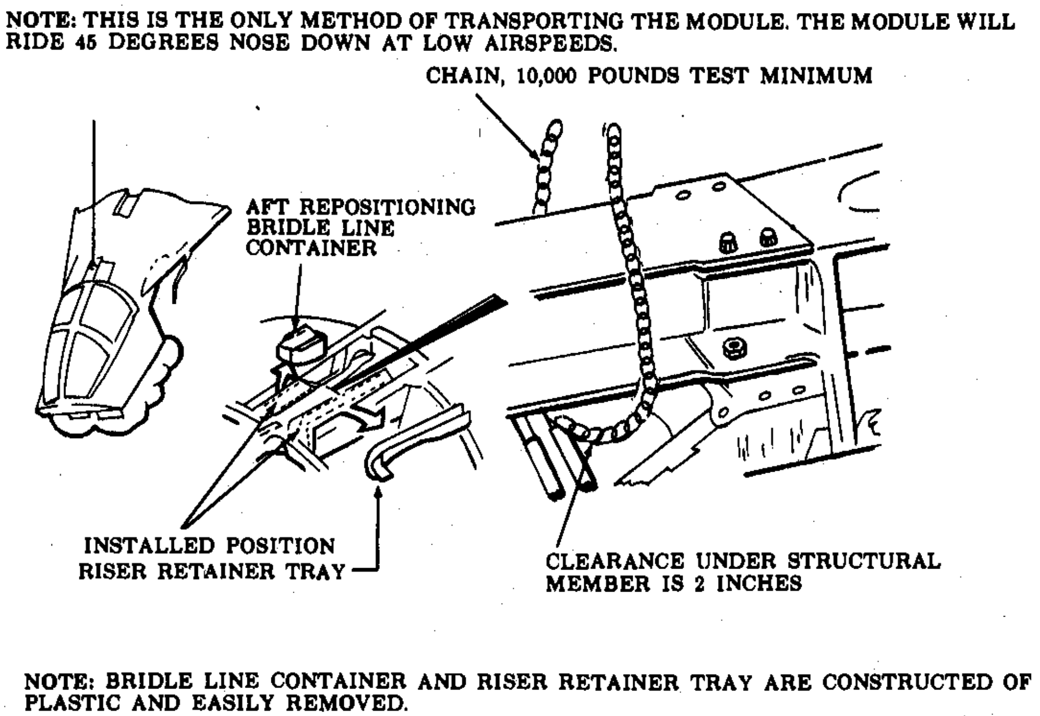


Figure 18-2. F-111 Module—Structural Attachment.

(1) The hookup person should insure that the module is stable prior to climbing into position to make the sling hookup. Care should be taken to prevent the helicopter downwash from blowing the hookup person off the module.

(2) Any changes in pickup methods or module configuration (i.e., damaged module, inflated flotation devices, longer sling, trapped water) may change the flight characteristics of the module and require a reduced airspeed.

Chapter 19

UNPREPARED (REMOTE) AREA OPERATIONS

19-1. General. This chapter provides guidance for the successful accomplishment of remote area operations. Each area of possible operations requires detailed knowledge of the problems you may encounter. Prior to performing an approach to a landing or hover, the aircraft commander must consider crew qualification, aircraft power and capability, weather (including winds), terrain, environmental factors, illumination, and mission requirement. The final decision to accomplish the approach or landing rests with the aircraft commander. Safety of flight must not be jeopardized for mission accomplishment. The decision by an aircrew to abort a flight or change their configuration due to weight consideration will be accepted by the Command.

19-2. Power Available Check. Perform a power available check prior to a hoist recovery or remote area operations or any time use of near-maximum power is anticipated. When not prescribed in the appropriate flight manual, perform the power available check as follows using maximum RPM: First, establish the preselected conditions (i.e., airspeed, altitude, and OAT) for which power has been precomputed; then increase collective to insure that the precomputed power is available. It may be required to check one engine at a time not to exceed engine or transmission limitations. (NA for UH-1N) Maintain rotor speed as prescribed by the flight manual during the check. Perform a power check as near as possible to the same pressure altitude and OAT conditions of recovery site. Perform the power available check either en route to, or at the recovery site. Compare power available against that computed for hover to insure that there is sufficient power available to complete the recovery. When power available is within 10 percent of power required a second aircrewmember will reconfirm power requirements with tabulated performance data (if available).

19-3. Aircraft Control Techniques. Remote operations depend upon individual pilot technique. The smoother the pilot flies, the greater the efficiency of the helicopter. Maintaining a steady rotor disc gives you the greatest lift with the least power. All remote approaches must be flown with the utmost precision, especially during the final approach phase. A pilot must not get in a hurry with fast or erratic approaches. Remote area approaches must not be so fast as to require a flare in order to terminate, nor should they be so slow as to cause translational lift to be lost before the helicopter is in an immediate position to land. These procedures require practice to perfect.

19-4. Remote Problem Areas. Most helicopter landing mishaps result from getting into a condition requiring instantaneous power for recovery or getting into a settling with power condition. Turbine engines require approximately 5 seconds to produce full power from idle power, thus if a pilot uses a fast approach with minimum power or a steep approach with a high rate of descent, he is asking the engine to produce the impossible after the helicopter is committed to a landing. Settling with power requires the helicopter to have three things simultaneously:

a. Loss of translational lift.

b. High rate of descent (usually in excess of 300 FPM).

c. Power applied to the rotor system. A poor approach may have all the necessary ingredients for settling with power. Add a slight downwind to a poor approach and you have the perfect recipe for getting into a full blown vortex ring state, from which recovery is impossible at low altitude.This chapter is designed to provide information to keep aircrews out of both of these conditions.

19-5. Preparation. During premission preparation, use all available parameters to insure aircraft and crew limitations are not exceeded. Consider available winds, terrain, power available/required and operating altitudes to prevent an inadvertent entry into an unrecoverable flight regime. Altitude and temperature are major factors in determining helicopter power performance. However, this information may not be available for the site of intended operation and will require evaluation on scene. Keep fuel load, equipment, and personnel to the minimum required to safely accomplish the mission. Accurate wind information is more difficult to obtain and more variable than other planning data. It is not advisable to include wind information in advanced planning data even though it may serve to improve performance. The aircraft commander must obtain and utilize all information available to him/her for adequate premission planning. Factors to be considered:

a. Flight Planning:
   (1) Mission requirements
   (2) Maps and charts
   (3) Crew qualification/quantity
   (4) Weather
      (a) Takeoff
      (b) Area of operations
   (5) Expected helicopter capability (TOLD)
   (6) Suitability of objective area
   (7) Route of flight
   (8) Fuel requirements
   (9) Possible deviations from directives
   (10) Communications
   (11) Special equipment
   (12) Support aircraft

b. Crew Briefing:
   (1) All factors pertaining to objective
   (2) Plan of action
   (3) Crew duties and responsibilities:
      (a) Pilot Flying. The pilot will verbalize his/her site evaluation and plan of action; request input from other crew members; and brief abort route and go/no-go decision points and procedures. Fly the aircraft using the parameters of the transition maneuvers; i.e., if a normal approach is briefed, all normal approach transition parameters apply. The pilot will advise the crew anytime he/she loses sight of the landing area and request directional input.

(b) Pilot Not Flying. Take an active part in providing accurate and timely input to the pilot flying. He/she will monitor the approach, landing and takeoff. He/she will confirm power requirements with the flight engineer. Be aware of the power available versus powered required and the power margin. Inform the pilot flying of the amount of power being applied. Monitor approach angle, approach path, airspeed, vertical velocity, attitude, and altitude. Make advisory calls for deviations. In the landing area, he/she will monitor engine instruments and help maintain adequate blade tip clearance.

(c) Flight Engineer/Mechanic. Compute TOLD for landing site to include power available versus power required with safety margin. Complete mini TOLD card prior to final approach on all remote site operations including operational sites. Power required will be computed with no wind for all training flights. Monitor approach angle, obstacle clearance, altitude and closure rates to the specific landing area. Clear the aircraft of all obstacles. If in the flight engineer station, monitor engine instruments, altitude, rate of descent, etc.

(d) Pararescuemen, Aerial Gunners, Scanners. Monitor approach angle, obstacle clearance, altitude, and closure rate to the specific landing area. Clear the aircraft of all obstacles.

(e) General Aircrew. Although the safe operation of the aircraft is the ultimate responsibility of the aircraft commander, it is also the responsibility of each crew member. Anytime there is confusion as to what is happening during the operation or to the aircraft, question it and get it clarified. If the aircraft or crew members are not performing correctly call "go around." Circumstances permitting, the pilot flying will initiate a go-around immediately and the situation will be discussed and clarified.

(f) Crew Coordination. Crew coordination is crucial to the successful accomplishment of a remote/confined area operation. At the pilot's discretion (or earlier if required) the FE/AG/PJ scanner will commence clear, concise, and coordinated directions and commentary on the progress of the approach and landing. The verbage normally used is similar to that used for hoist operation. FE/AG/PJ scanners must be able to quickly discern deviations and provide on-the-spot directions to the pilot. As the approach proceeds closer to the landing area, directions should become more detailed with emphasis placed on obstacle clearance. Once below the level of the obstacles, the pilot should not move the aircraft in any direction he/she cannot clear without specific directions and clearance from the FE/AG/PJ scanners.

NOTE: Pilot selection and announcement of the specific spot to which he/she intends to shoot the approach not only focuses attention on shooting a precise approach, but provides the FE/AG/scanners the information they need in order to give precise instruction. This technique minimizes coordination delays at the end of the approach.

c. Aircraft Preparation:
(1) Required equipment
(2) Fuel required
(3) Weight and balance

19-6. Area and Site Evaluation:

a. The site evaluation consists of a high and low reconnaissance. The pattern flown during the landing site evaluation is dictated by terrain, wind, obstacles, and emergency landing areas. Plan the pattern to remain oriented in relation to the wind and intended landing area. Although there is not a standard pattern that covers all situations, a rectangular or modified rectangular traffic pattern should be flown. A pinnacle landing area may require flying around it at a constant altitude to afford you a look at the site from all possible angles. This reconnaissance may also give you areas of up-and downdrafts indicating wind speed and direction. Execute as many fly-bys as necessary.

(1) High Reconnaissance. The high reconnaissance is flown at approximately 300 feet above the site, offset to the side, and into the wind (if direction is known). Minimum airspeed is 50 KIAS. During this reconnaissance, evaluate the following:
(a) Free air temperature/site temperature
(b) Power available/power required (IAW paragraph 19-2)
(c) Site elevation
(d) Area for suitability/size, slope, surface
(e) Wind direction
(f) Approach/departure routes
(g) Turbulence
(h) Escape route

(2) Low Reconnaissance. The low reconnaissance allows refinement of items noted in the high reconnaissance. The pilot should fly the low reconnaissance as nearly as possible on the same approach angle and route selected for the final approach. The low reconnaissance serves as a "practice approach" to aid in determining the safest final approach. If the selected approach route is not satisfactory, select another route and execute another low reconnaissance. Pilots may descend to a minimum of approximately 50 feet above the highest obstacle along the flight path. Fly to the side of the site at a minimum of 50 knots and reconfirm the following:
(a) Approach route
(b) Escape route
(c) Wind
(d) Size, slope, surface
(e) Specific landing spot
(f) Site elevation
(g) Departure route

NOTE: During the low reconnaissance the pilot not flying will reconfirm site elevation and temperature.

b. Site Evaluations Without a High and Low Reconnaissance. At the pilot's discretion, the low reconnaissance may be performed on final approach if "OGE power" is available. There are occasions when the high and low reconnaissance need not be performed, such as:

(1) When performing tactical approaches (IAW paragraph 19-7e(3)).

(2) During successive approaches where conditions are equal to, or less stringent than a previous approach to the same area.

(3) During an mission where, in the judgment of the aircraft commander, the accomplishment of the high and low reconnaissance would degrade mission accomplishments.

(4) During a HH-53H coupled approach.

c. Wind Determination. Wind is the most variable of all factors and must be constantly evaluated. Prior to descent for a high reconnaissance, the pilot should have a general idea of wind direction and velocity. There are several methods of determining wind direction and velocity. The most reliable method is the use of smoke generators. The hand-held day/night distress signal is satisfactory for wind indication, but constitutes a fire hazard when used in areas covered with combustible vegetation. In situations that do not permit use of smoke generating devices to evaluate the wind, other methods must be used. One method is helicopter drift; however, the accuracy of this method depends on the wind velocity. This procedure is nothing more than setting up a constant airspeed and angle of bank and exposing the aircraft to the wind as you make a turn. As the site is approached, roll into a turn so as to pass directly over the site at a constant airspeed and angle of bank. After completion of a 360 degree turn, note your position; the wind is blowing from the site to your position. Another method of determining wind direction is to deploy a streamer over a known position and visually follow it to the ground. Wind direction can also be determined from foliage, ripples on water, blowing sand, snow or dust. The doppler may also be used to read wind direction and velocity.

d. Include these operational considerations in unprepared (remote) area operations:

(1) Does the need to land justify the risk to aircraft and crew?

(2) Is ground effect assured at the landing or hover site?

(3) Should you download at an alternate landing site to decrease gross weight and increase power reserve?

(4) Is fuel dumping, as authorized IAW paragraph 6-66, necessary?

(5) What is the effect of wind and ground effect during the approach?

(6) Will weight to be picked up result in an unsafe power margin?

(7) Will the power required for takeoff be greater than the power required for landing.

19-7. Approach:

a. General. Standard approach maneuvers are intended for use on all missions; however these standards may not reflect the optimum performance required for remote site operations. Deviations from these standards may be required to accomplish mission objectives.

WARNING

To prevent the possibility of entering power settling during remote area approaches, do not exceed the vertical velocity limits established for a steep approach, during the last portion of the approach. Remain strictly within aircraft limitations; there are no <u>deviations for rate of descent</u>.

There is no one approach that should be used for every situation. The type of approach angle and direction of approach should be determined by the height of the obstacles at the landing site. (It makes no sense to select an approach perpendicular to a ridgeline to avoid obstacles and then fly a steep approach.) The transition period (transitioning from forward flight to hover flight) is the most difficult part of any approach. As helicopter performance decreases, select an approach angle which will make transition more gradual. As the height of obstacles increases, larger landing areas or additional power will be required. If marginal operating conditions exist, either lighten the helicopter, locate a more suitable area, or abandon the mission.

b. Approach Techniques. All approach angles are apparent, the exact angle of a remote site approach cannot be dictated. Aircrews should attempt to establish a specific final approach entry altitude (i.e., 500 ft H-53, 300 ft all other helicopters) prior to attempting an approach so they are using a familiar sight picture. The normal approach should be considered for use in almost all cases. The steep approach requires the pilot to stop the rate of descent at the same time the helicopter is coming out of translational lift, which may require more power than is available. However, a steeper than normal approach may be required for adequate clearance of obstacles and avoiding null areas (due to wind). A shallower than normal approach allows the rate of descent to be stopped prior to the loss of translational lift. This allows the ground cushion to be picked up with the pilot in full control of the sequence of events. Remote site approaches require an aircrew to be alert and keep a comparison of indicated airspeed and groundspeed prior to actual touchdown—with a go-around planned at all times. On short final, before the helicopter is committed to land, analyze these three variables: proper rate of closure with translational lift; rate of descent under control; power smoothly increasing but below hover power.

(1) Confined Area. A confined area approach need be no steeper than any other type of approach. Some confined areas with high barriers will not allow the touchdown point to be kept in sight during the approach without using an excessively steep approach angle. A common problem associated with a steep approach over a barrier is that translational lift may be lost when the helicopter is possibly 100-200 feet above the ground. This puts the helicopter in a pre-settling with power or full settling with power condition, depending on the sink rate. The confined area approach should use a normal approach angle using the top of the nearest obstacles as a simulated touchdown point. This gives a precise point to plan the approach. The approach is done as though an actual landing will be made above the obstacle. The approach is continued until the actual touchdown point in the forward usable third of the area is in sight. At this point, the rate of descent should be very low (less than 300 FPM), and the power for landing should be steadily increasing. The final portion of the approach is completed by flying down to a touchdown avoiding any additional rate of descent.

(2) Pinnacle/Ridgeline. The first step for pinnacle/ridgeline approaches is to plan the approach so you have an out (i.e., at any time you can abort the approach successfully). All approaches to ridgelines should be down the ridgeline unless overriding conditions exist which make it impossible. The least preferred approach to a ridgeline is perpendicular to the ridgeline. Should you have to select between an approach with a left quartering headwind or a right quartering headwind, select the left quartering headwind. This is due to the aircraft wanting to weather vane left, causing increased right pedal, decreased pitch, decreased drag, and ultimately less power. If

power is marginal, avoid wind from the right, but at the same time, plan your abort to the right. Remember on pinnacle and ridgeline approaches to land the helicopter to the site, not your seat. Landing to your seat could result in landing short of your intended area. During a pinnacle approach your eyes will perceive a slight overarc on short final. Use the low reconnaissance to practice the approach and pay attention to the approach angle so you will know what to expect on final approach.

(3) Visual Illusions. During an approach, you must be aware that uneven terrain surrounding the landing site gives poor visual cues as to the actual aircraft altitude and rate of closure. Where the terrain slopes up to the landing site, a visual illusion occurs, giving you the feeling that the aircraft is too high and the rate of closure is too slow. If the terrain slopes down to the landing site, you will experience the feeling that the aircraft is too low and the rate of closure is too fast. When approaching a pinnacle where the terrain falls off sharply, you will experience the feeling the aircraft is too high and the rate of closure will initially appear to be too slow; but as you get closer, the apparent rate of closure will appear excessive. You must be aware of these illusions and overcome the temptation to make unnecessary control movements. Reference to the flight instruments during the approach is necessary to insure a safe approach. Simply meeting the parameters of the type of approach flown does not guarantee the success of the approach. The crew must continue to maintain the selected angle and control the rate of descent, especially during the last 100 feet. Prior to decelerating below translational lift, the pilot should consider altitude remaining and insure that the approach can be safely completed on the selected angle. Once translational lift is lost, the possibility of a go-around is marginal or nonexistent.

NOTE: Aircrews should be aware of the need for a rapid response to "go-around" on pinnacle/ridgeline approaches. Rather than call out the specific condition of a parameter (i.e., "800 FPM"), the copilot should call "go around." Aircrews should also expect the possibility of several aborted approaches because of the existing hazards and exacting requirements for a safe, successful approach.

c. Winds. The following factors should be considered:

(1) Moderate to Strong Winds. Moderate to strong winds normally will require you to use a steeper than normal approach angle to be into the wind and avoid the null area and associated turbulence downwind of a ridgeline or pinnacle. Use these winds to assist you in maintaining translational lift and prevent you from encountering the loss of translational lift that is normally associated with steep approaches. Remember a one mile per hour wind blowing downslope is 88 FPM. A five mile per hour wind blowing down slope is 440 FPM, this can easily exceed your aircraft's rate of climb. Do not allow the aircraft to fly through this downwind downslope condition when below translational lift.

(2) Light and Variable Winds. Light winds normally will allow you to take advantage of the best approach path based on terrain and obstacles. However, marginal power approaches, coupled with light and variable winds, can result in the pilot inadvertently placing the aircraft in a settling with power condition. Light and variable wind conditions could result in a tailwind component on final approach, causing the pilot to add additional aft cyclic, thus placing the aircraft in a regime for which power is insufficient. Pinnacle and perpendicular ridgeline approaches may add to the problem by denying the pilot apparent closure rate visual cues normally experienced over flat terrain. Due to the insidious onset of settling with power under these conditions, pilots must insure airspeed is maintained above translational lift until committed to a landing/hover. Marginal power conditions and the existence of light and variable winds may dictate that an approach to a pinnacle or perpendicular to a ridgeline not be attempted.

d. Approach Planning Factors. Consider the following factors:

(1) Plan an abort route, preferably downhill and/or into the wind without climbing. If it is necessary to turn during an abort, a right turn is preferable (terrain permitting).

(2) Avoid high rates of descent during approach.

(3) Be alert for wind shifts and downdrafts.

(4) Monitor rotor RPM for any droop throughout the approach.

(5) Any landing site with obstacles on the upwind side will subject the helicopter to a null area (an area of no wind or, in some cases, a downdraft). It is important that this null area be avoided if marginal performance capabilities are anticipated. Never plan an approach to a confined area where there is no reasonable route of departure.

e. Types of Approaches. Approaches defined here may be used in any situation with the exception of night or water operations which are covered elsewhere. There are three types of approaches: (i) traffic pattern approach, (ii) turning approach, and (iii) tactical approach.

(1) Traffic Pattern Approach. This approach normally is flown from a rectangular or modified rectangular pattern where level flight can be established on the initial segment of the final approach prior to starting a descent. It is particularly applicable for fixed base operations, pinnacle approaches, student training, and where depth perception is a problem.

(2) Turning Approach. This approach may be entered from any position in relation to the landing/hover area. Maneuver and descend as necessary to a point on final where a controlled straight-in approach can be flown to the site. The point of rollout on final varies with the entry point altitude, and power reserve, but should be accomplished high enough to avoid the need for rapid flares, abrupt control movements, or large collective input. Avoid low airspeeds while downwind, especially in strong winds. High angle bank turns should be avoided. Improperly executed descending turns under such conditions can result in rapid loss of lift from which there may be insufficient altitude/power to recover.

(3) Tactical Approach. This approach is used during missions that require low altitudes for ingress to the survivor's position, maneuvering in a limited area, and transitioning into a landing/hover with minimum exposure. Included in tactical approaches are high and low speed straight ahead approaches, and 180 degree, 270 degree, and 360 degree approaches. This approach is more demanding than any other approach and may

involve constant change of approach angle, airspeed and rate of descent. Keep the crew informed of position in the approach. This enables the crew to clear the flight path for the pilot.

(a) The tactical approach may be started from any position in relation to the landing/hover area. Accomplish the prelanding check prior to initial descent. Be aware of tail rotor clearance throughout the deceleration phase. Align the final portion of the approach into the wind, if possible. At high density altitudes with heavy gross weights, anticipate blade stall. Anticipate power increases prior to completion of decelerations. If not anticipated, the engine(s) may not have sufficient time to accelerate. To avoid power settling, do not exceed the vertical velocity limits established for a steep approach during last portion of the operational approach. Constantly monitor main rotor RPM to prevent main rotor overspeeds.

(b) Tactical approaches will only be performed during:

1. Special operations training.
2. Combat SAR training.
3. Missions where the risk of flying a normal rectangular pattern or turning approach would be greater than maneuvering directly for an approach or landing.

19-8. Hover. Upon arriving at a hover over an intended landing area allow the helicopter movement to stabilize. Hovering over trees and uneven terrain requires additional power because full ground effect is not realized. Survey the landing area and determine the best landing spot. If possible, select a level area, free from obstructions. Take care when landing in low brush. Small branches and bushes flatten with rotor wash, but could spring up into the rotor blades after shutdown. Check for stumps, rocks, or depressions which could be hidden by grass. Keep in mind that there is very little clearance between the bottom of the aircraft and the ground.

a. If the condition of the landing zone cannot be determined from the helicopter, it may be advisable to hoist a crew member to the ground to perform a survey. This crew member could also be used to improve the landing area and aid the pilot during aircraft touchdown.

b. When hovering over loose snow or dust, be prepared for an immediate takeoff. Blowing dust or snow may cause loss of visual references and spatial disorientation. To avoid this, sight in on a small tree or boulder near your landing site.

19-9. Landing. Lower the helicopter gently to the ground. Maintain rotor RPM and slowly decrease collective pitch. Be ready for an immediate takeoff if the helicopter starts to tip. Be aware of your aircraft slope limitations.

19-10. Takeoff. Recompute or confirm adequate power required to hover if you have added personnel or other weight to the helicopter. Complete the before takeoff checklist, if required. (H-53s may use the dashboard placard, but must insure doors, windows, ramps, and personnel are secured.) Recheck the wind direction and velocity. Determine the best departure route consistent with the wind direction and select a takeoff abort point. Use maximum rotor RPM for takeoff. In a confined area takeoff, attain a safe single-engine envelope as soon as possible. If the wind is light and variable, an inadvertent downwind takeoff could adversely affect aircraft performance. If takeoff power is reduced prematurely, safe obstacle clearance may be jeopardized. The null area is of particular concern in making a takeoff from a confined area. Under a heavy load or limited power conditions, it is desirable to achieve translational lift, before encountering a null area and prior to climbing so the overall climb performance is improved. In the vicinity of the null, a nearly vertical downdraft may be encountered further reducing the climb rate. Under certain combinations of limited area, high upwind obstacles, and limited power available, the best takeoff route may be crosswind. Even though this is a departure from the cardinal rule of "takeoff into the wind," it may be the proper solution when all factors are weighed. When obstacle clearance is of primary concern, the pilot's attention is concentrated outside the aircraft. These circumstances require increased crew coordination. When safely airborne, establish radio contact with any available source and notify them of your intentions, needs, conditions of survivors, and other pertinent information. This information can then be relayed to your controlling agency.

19-11. Mountain Flying Considerations:

a. Demarcation Line. The point which separates the upflow from the downflow of air is called the demarcation line. It forms from the highest point of the mountain and extends diagonally upward. The velocity of the wind and the steepness of the uplift slope will determine the position of the demarcation line. Generally speaking, the higher the windspeed and steeper the terrain, the steeper the demarcation line. It is recognized by the change in symptoms between upflowing and downflowing air. The effects of the varying wind velocities on the demarcation line are:

(1) Light Winds (1 knot to 10 knots). A light wind blowing will accelerate slightly on the upslope, giving rise to a gentle updraft; follow the contour of the terrain feature over the crest; and at some point past the crest, turn to a gentle downdraft. The demarcation line lies at a relatively shallow angle from a point on the upwind side of the hillcrest. (Figure 19-1)

(2) Moderate winds (11 knots to 20 knots). Moderate wind will increase the strength of the updrafts and downdrafts, and create moderate turbulence. Updraft will be experienced on the upwind slope near the crest of the mountain. The demarcation line forms closer to the hillcrest and is steeper. (Figure 19-2)

(3) Strong Winds (above 20 knots). As the wind increases, the demarcation line will move forward to the leading edge of the hillcrest and will become progressively steeper. The severity of updrafts, downdrafts, and turbulence will also increase. Under these conditions, the best landing spot is close to the forward edges of the terrain feature. (Figure 19-3)

b. Mountain Approach Considerations. There is no standard type of mountain approach. Ideally, it is made directly into the wind using a constant angle of descent; however, when certain conditions exist, a crosswind approach may be best. In a light wind or when the demarcation line is shallow, a relatively low angle of descent or a shallower than normal approach should be used. This type of approach requires less power and control movement; however, if downdrafts are encountered, insufficient altitude may be available

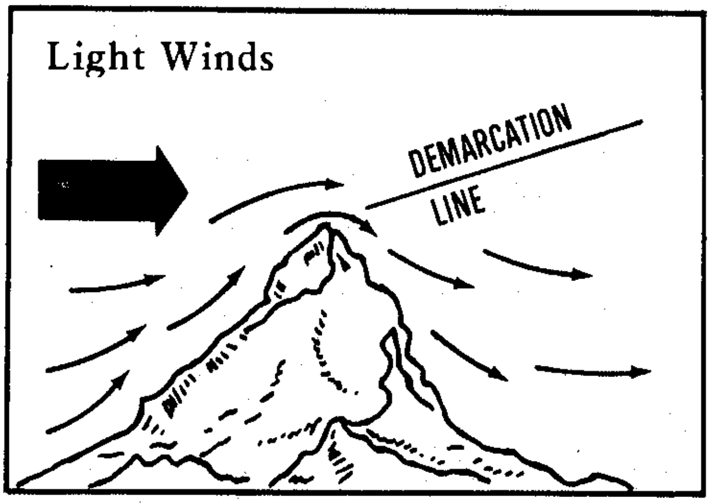


Figure 19-1. Light Winds.

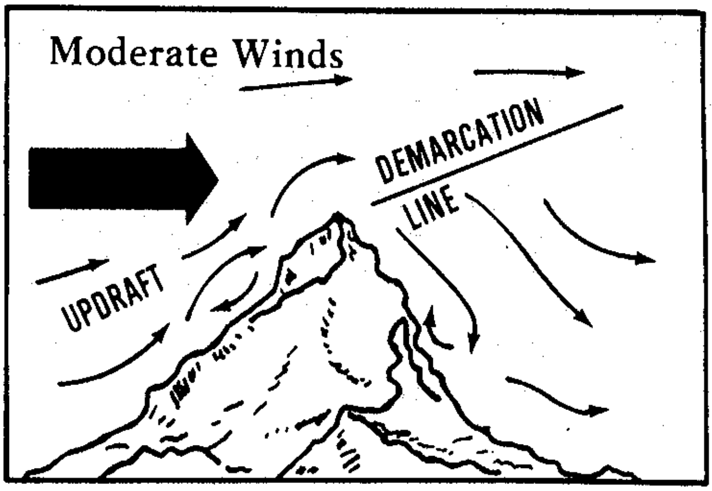


Figure 19-2. Moderate Winds.

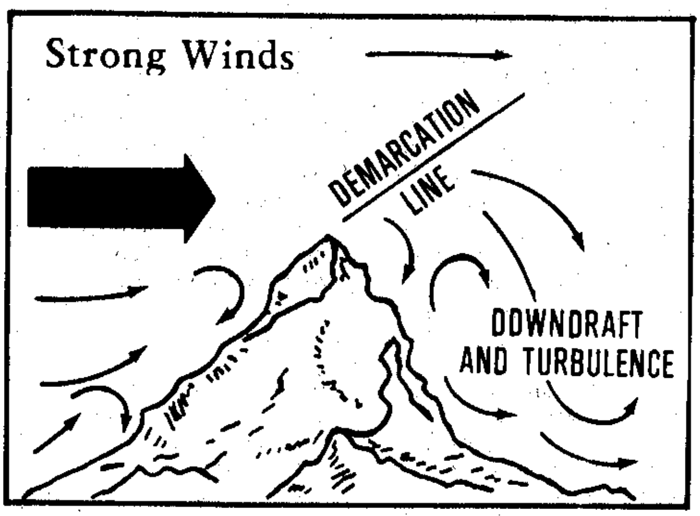


Figure 19-3. Strong Winds.

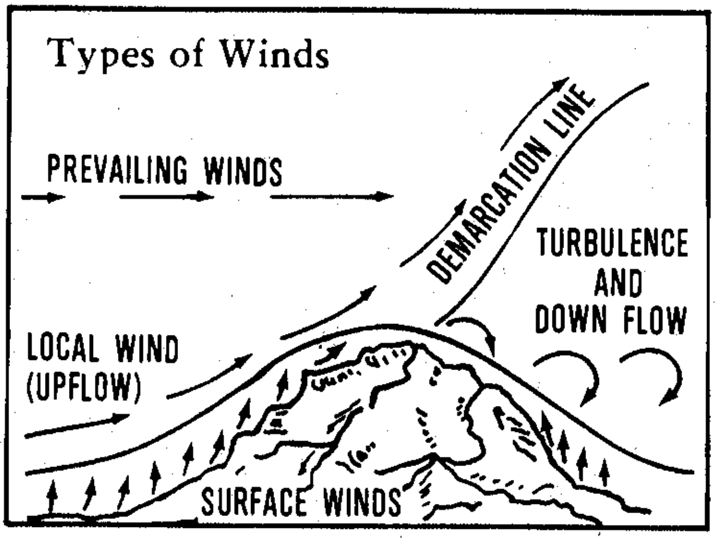


Figure 19-4. Types of Winds.

to continue the approach. As the wind velocity increases and the demarcation line becomes steeper, the approach angle must also be steeper. This type of approach has a higher rate of descent and requires more power to terminate the approach; however, it provides more terrain clearance if downdrafts are encountered during the approach.

c. Approach Paths and Areas to Avoid. Selection of an approach path in mountainous areas should include a consideration of the following:

(1) Wind Direction and Velocity - It is desirable to land into the wind; however, the terrain and/or its effect on the wind may require that a crosswind landing be made. If feasible, plan a crosswind approach so that the wind is from the left side of the aircraft. This condition will assist in overcoming the effects of torque, reduce the power required, and aid in heading control.

(2) Vertical Air Currents - It is desirable to have updrafts on the approach path. Avoid suspected areas of downdraft.

(3) Escape Routes - A critical consideration, there should be one or more escape routes along the approach path that can be used if a go-around is required.

(4) Terrain Contour and Obstacles - These determine what approach angle you will use. Avoid an approach path over terrain/obstacles that force you into a steeper angle than you feel comfortable with. When possible, select a landing point on or near the highest terrain feature.

(5) Position of the Sun/Moon - Although the wind direction and nature of the terrain are the primary factors in selecting an approach path, consideration should be given to the location of the sun/moon relative to the approach path and the presence of shadows in the landing site. If the landing point is in a shadow, the approach path should also be in a shadow. This would eliminate problems due to the eyes adjusting from one light condition to another and provide the smoothest air. An approach directly into the sun/moon should be avoided where it is low on the horizon.

Examples of approach paths and areas to be avoided are shown in figure 19-5.

19-12. High Density Altitude Considerations. Operations conducted above 7,000 feet density altitude require detailed knowledge of the hazards associated with this area of operations. All available information must be used to safely accomplish remote site operations in this environment. Temperature has the greatest effect on density altitude. For every 1°C increase in temperature the density altitude will increase approximately 120 feet. An increase in humidity will also increase density altitude. (Figure 19-6) True airspeed is directly related to density altitude. With a constant indicated airspeed, an increase in density altitude will result in an increase in true airspeed. The following factors must be carefully considered:

a. Power Settling. The pilot must initiate control input smoothly, employing finesse, while performing at high density altitude. Rapid or excessive aft cyclic will greatly increase the induced drag factor on the rotor system. This additional drag will impact directly on power required to maintain airspeed and vertical velocity (rate of descent) and could lead to the onset of power settling. Once power settling is encountered, helicopter power alone is inadequate to effect a recovery. Recovery can only be accomplished by lowering the collective and nose to fly out of the disturbed air, this will result in the loss of considerable altitude.

b. Translational Lift. The result of a premature loss of translational lift can result in limited options or a crash if OGE power is not available. At high density altitude (DA) the IAS/TAS relationship is significant. On final approach at high DA you will lose translational lift at an earlier stage. Similarly you will achieve translational lift at a later stage on go arounds or takeoffs. Inertia is also related to TAS not IAS. The aircraft appears to take longer to decelerate at higher altitude. Don't rush! Fly the basics... plan for longer finals and expect to bring the power in earlier during the approach. If power is marginal, avoid winds from the right. Also, remember your best abort route is to your right, terrain permitting.

c. Power Required. Power required charts are based on having ground effect. When making a landing

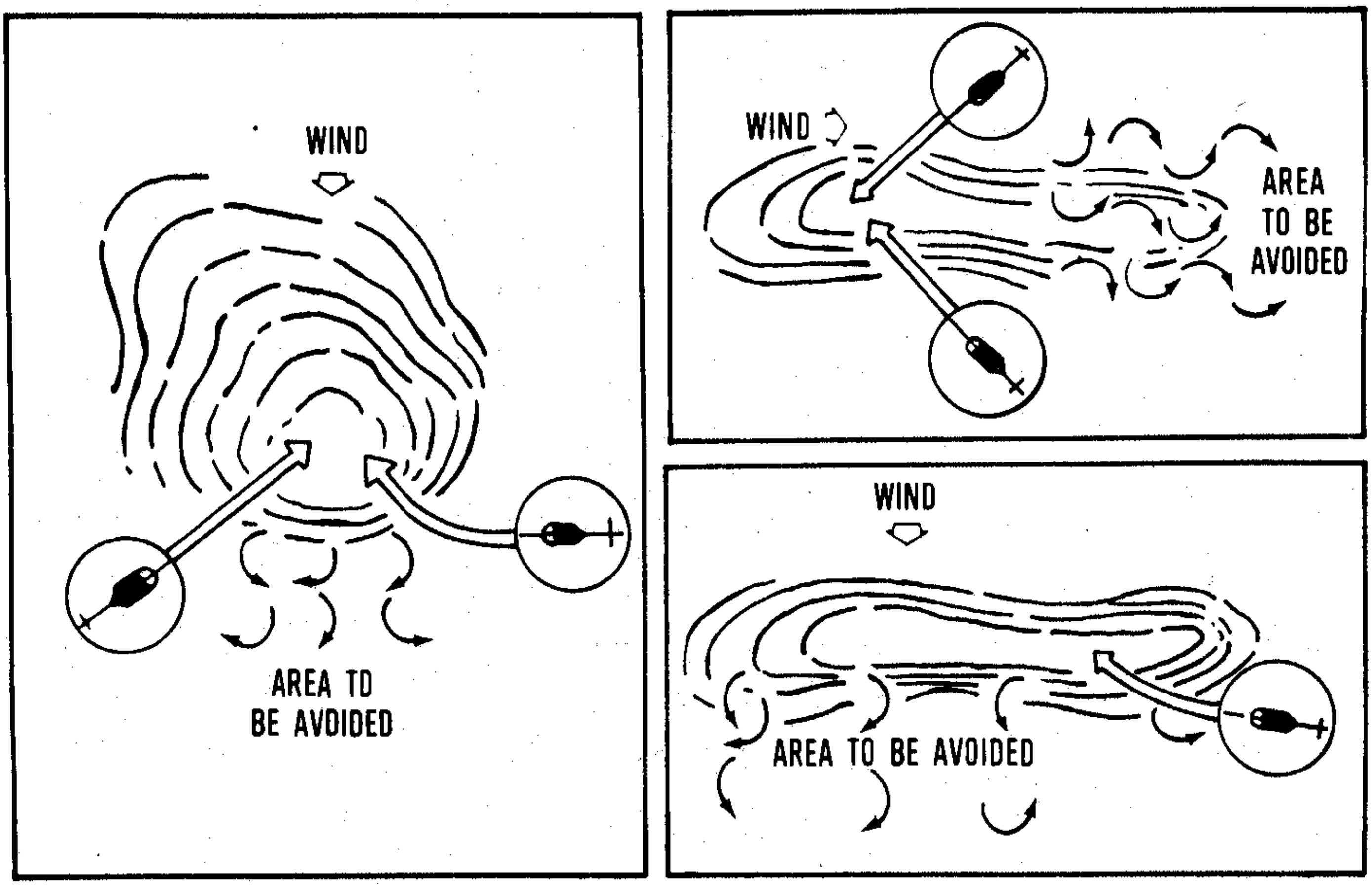


Figure 19-5. Approach Paths and Areas To Avoid.

to a site that is less than the diameter of your rotor system, such as a pinnacle or ridge line, aircrews must insure sufficient power is available. The degree of slope also affects your power required, due to loss of ground cushion.

(1) When landing to a surface area smaller than your rotor diameter, such as a pinnacle, power for an OGE hover should be available.

(2) When landing to an area where the flat surface is not at least two rotor diameters, power for a 20-foot hover should be available. (This is an approximate power requirement to provide a margin of safety.)

(3) If power requirements are not available, either lighten the helicopter, locate a more suitable landing site, or abort the mission.

d. Power Available. Determine actual altitude of the site. If a radar altimeter is installed and operative, fly directly over the site. At that time, cross-reference the radar altimeter with the barometric altimeter (set to 29.92" HG) to determine the PA and confirm the elevation of the site. The aircraft commander normally assigns this responsibility to the copilot. The power available check will be accomplished prior to the low recon. If any differences are noted, power will be recomputed.

e. Bubble Effect. Temperature, terrain and weather can significantly affect surface temperatures. High density altitude, clear skies, and vegetation can cause a bubble effect on mountain tops that can result in surface temperatures 8° to 15°C warmer than the same elevation outside of the bubble. The best potential condition for a bubble effect is high mountain vegetated terrain under high pressure. If you suspect that the bubble effect is present, plan on your power requirements being higher based on the possible higher temperature.

f. Approach. Prior to the approach, brief all crew members on the specific approach procedures, pilot's intentions, significant terrain features, specific crew requirements, and abort route. To avoid power settling, do not exceed the vertical velocity limits established for the type of approach being flown. If at any time during the approach the conditions do not appear favorable or safe, a go-around should be accomplished. It is not uncommon to attempt numerous approaches in a high DA environment.

g. Go-Around Decision. The decision to go-around may be delayed too long based on aircraft and crew capability. Several factors influencing the decision to go-around are:

(1) Approach angle too steep or shallow.

(2) Excessive movement of controls to maintain angle.

(3) Rate of descent exceeds limitation.

If a go-around is executed in marginal conditions, the possibility of a successful go-around is sharply reduced or nonexistent. Total crew involvement is paramount on all approaches to identify the need, and call for a go-around in a timely manner. Depending on circumstances, go-arounds may be planned as high as 200 feet AGL.

1. START WITH AN OBSERVED OR FORECAST RH VALUE. FROM THE BOTTOM OF THE GRAPH MOVE VERTICALLY TO THE OBSERVED OR FORECAST TEMPERATURE (EXTRAPOLATE FOR TEMPERATURE AS NECESSARY).
2. MOVE HORIZONTALLY TO THE LEFT ANO REAO OFF THE DA CORRECTION VALUE
3. ADD THIS CORRECTION TO THE ORIGINAL OA VALUE (OBTAINED USING FREE AIR TEMPERATURE AND PRESSURE ALTITUOE).

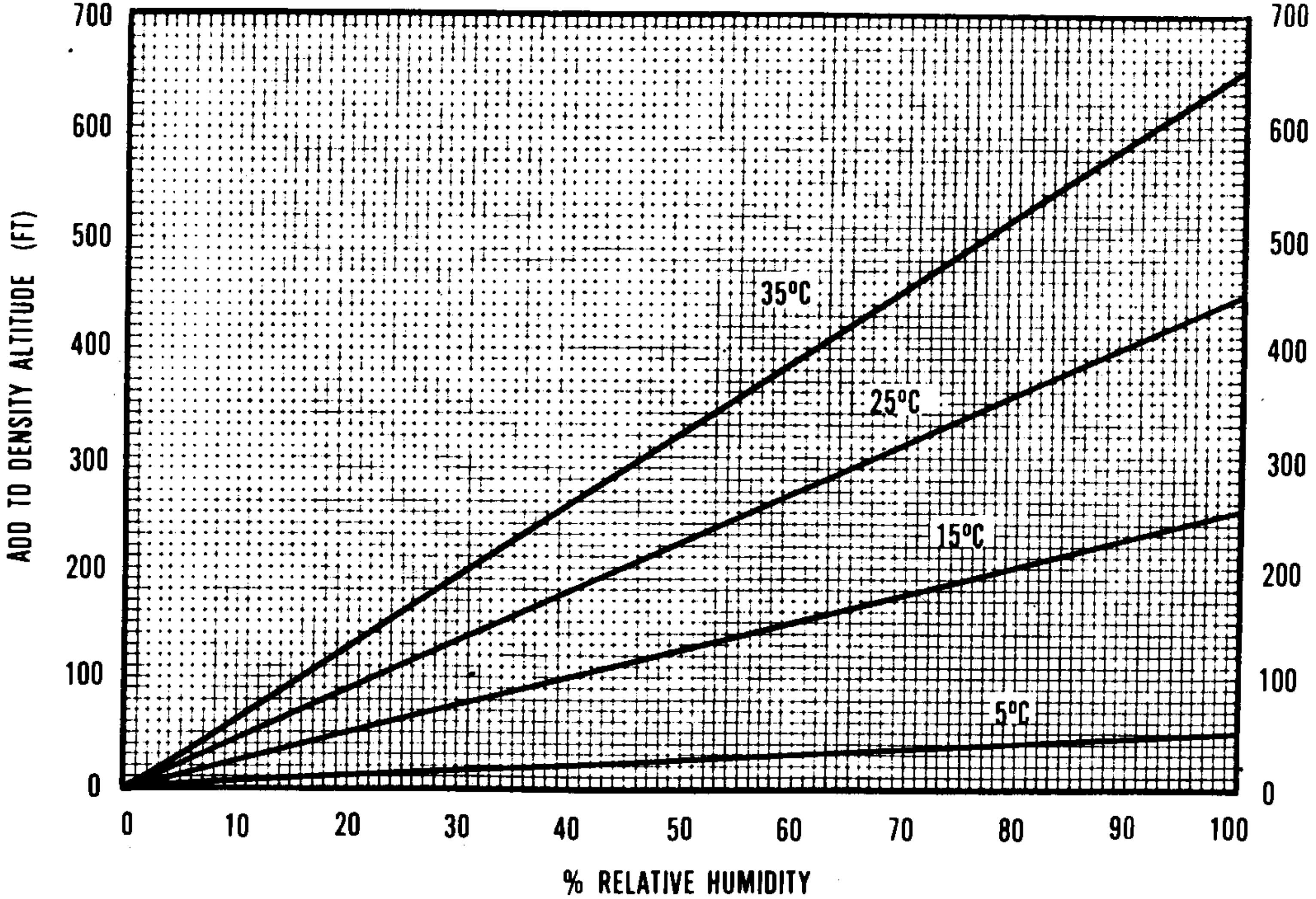


Figure 19-6. Density Altitude Correction Based On Relative Humidity.

h. Abort or Land. Past a certain point, you cannot abort the approach. What do you do?

(1) Hold maximum power.

(2) Don't droop below minimum Nr. Excessive drooping of the rotor system may result in loss of tail rotor authority.

(3) Descend into ground effect.

(4) If you cannot stop your descent, select a spot and fly the aircraft as smoothly as possible to a touchdown. Do not make any abrupt movements of the controls. Attempt to smoothly fly the aircraft to your intended spot knowing you cannot stop your descent. (If your aircraft possesses external stores it may be necessary to jettison them to reduce your rate of descent or allow you to make a go-around.)

i. Potential Effects of High Density Altitudes:

(1) Power available decreases.

(2) Power required to hover increases slightly.

(3) The power margin decreases.

(4) Max allowable airspeed decreases.

(5) Control response becomes more sluggish due to diminished power margin.

(6) The potential for blade stall increases.

(7) The potential for the formation of the Vortex Ring State increases.

(8) The potential for power settling increases due to the reduced power margin.

19-13. Tail Rotor Factors:

a. General. You must anticipate conditions which can lead to rotor system decay during preflight planning. You need to be able to anticipate the possibility of adverse relative winds whether natural or artifically produced. You cannot accept winds from the left, right and/or rear when your aircraft is heavy and requires close to maximum power available. Maximum demands on the tail rotor are the same as those on the main rotor:

(1) High DA, especially when combined with high humidity (see figure 19-5).

(2) High gross weight.

(3) High OAT.

(4) Hovering out of ground effect.

(5) Low airspeed, especially during takeoff when combined with a left turn.

(6) Steep angles of bank while trying to maintain altitude and airspeed.

(7) Confined areas (due to loss of wind for translational lift caused by descending below a tree or ridge line).

(8) Hovering over uneven surfaces (part of the rotor system out of ground effect).

(9) Any maneuver requiring high power.

b. Loss of Tail Rotor Effectiveness. You must avoid situations which will cause the tail rotor to exceed its ability to produce thrust. Power requirements need to be closely monitored and applied with care. Early recognition of loss of tail rotor effectiveness is essential to successfully and safely initiating corrective action. In general there are four conditions which contribute to loss of tail rotor effectiveness:

(1) High Power. Any maneuver that requires high power and therefore high tail rotor thrust can cause tail rotor problems. When the rotor system demands more power than the engine(s) can produce, the main and tail rotor RPM will begin to decay. As the tail rotor RPM decays, tail rotor pitch only accelerates the decay until eventually there is insufficient thrust available to maintain heading, causing the nose of the aircraft to yaw to the right. Left pedal corrections at this point will only continue to aggrevate the situation. If tail rotor stall occurs it will cause an abrupt yaw to the right. To recover, you must lower the collective, increase airspeed, initiate a right turn, if possible, and initiate a right turn, if possible, and initiate a go around. In order for the recovery to be successful, the pilot must recognize the situation early enough to insure sufficient altitude for a safe go around.

(2) Decelerative Attitude and Low Airspeed. A decelerative attitude may result in a combination of downwash from the main rotor and turbulence from the synchronized elevator (H-1), passing through the tail rotor. Low airspeed and high power settings also increase main rotor turbulence through the tail rotor. In both bases you will require more left pedal to maintain aircraft heading. This could increase the potential for loss of tail rotor effectiveness in some situations.

(3) Left Crosswind or Left Sideward Flight/Right Pedal. These conditions could cause the tail rotor to operate in turbulence similar to the main rotor during power settling. Left sideward velocities of 5-35 knots (depending on aircraft loading) can cause the tail rotor to work in its own downwash. As a result the pilot will have difficulty maintaining directional control, due to large variations in tail rotor thrust. These phenomena are referred to as vortex ring and tail rotor breakaway. To correct the problem slow/stop sideward flight/pedal turn and gain airspeed.

(4) Right Crosswind or Right Sideward Flight/Left Pedal Turn. A right relative wind acting on the fuselage area tends to push the tail to the left requiring more tail rotor thrust to maintain heading. As the aircraft is flown at higher gross weights, higher right relative winds, higher DAs, higher humidity, etc., full left pedal may be exceeded. To correct the situation gain airspeed and/or initiate a right turn if possible. Running out of left pedal is the most common tail rotor problem for helicopter pilots.

19-14. Obstacle Clearance. The aircraft commander has the ultimate responsibility for obstacle clearance. If possible, use additional crew members as scanners to assist the pilot. Insure that scanners are thoroughly briefed and aware of their duties/ responsibilities involving obstacle clearance. Post scanners on both sides of the helicopter. When only one scanner is available, position on the same side as the pilot who is flying. Prior to maneuvering a helicopter in close proximity to obstacles, ascertain that the area is clear. Whenever horizontal rotor clearance is 25 feet or less, the scanner informs the pilot of the estimated distance and the clock position to the aircraft (for example: "Tree, 20 feet, nine o'clock").

19-15. Turbulent Air Flight Techniques:

a. Helicopter pilots must be constantly alert to evaluate and avoid areas of severe turbulence. However, if encountered, immediate steps must be taken to avoid continued flight through it. To preclude exceeding the structural limits of the helicopter utilize the procedures in the flight manuals. Severe turbulence is often found in thunderstorms, and helicopter operations should not be conducted in their vicinity. The most frequently encountered type of turbulence is orographic turbulence. This turbulence is normally associated with updrafts and downdrafts and can be dangerous if severe. It is created by moving air being lifted or depressed by natural or man-made obstructions. It is most prevalent in mountainous regions but can be encountered over level terrain.

b. The severity of orographic turbulence is directly proportional to the wind velocity. It is found on the upwind side of slopes and ridges, near the tops, and extending down the downwind slope. Its extent on the downwind slope depends upon the strength of the wind and the steepness of the slope. If the wind is fairly strong (15 to 20 knots) and slope is steep, the wind generally will blow off the slope and not follow it down. However, there will still be some tendency to follow the slope. In this situation, there will probably be severe turbulence several hundred yards downwind of the ridge at a level just below the top. Under certain atmospheric conditions a cloud may be observed at this point. On more gentle slopes, the turbulence will follow down the slope but will be more severe near the top. Orographic turbulence will be affected by other factors. The intensity will not be as great when climbing a smooth surface as when climbing a rough surface. It will not follow sharp contours as readily as gentle contours.

c. Rising air currents created by surface heating causes convective turbulence. This is most prevalent over bare areas. Convective turbulence normally is found at a relatively low height above the terrain, generally below 2000 feet. It may, under certain conditions, reach as high as 8,000 feet. Turbulence can be anticipated when transitioning from bare areas to areas covered by vegetation or snow. Convective turbulence seldom gets severe enough to cause structural damage; however, increasing altitude will decrease turbulence and provide a smoother flight.

d. The best method to overfly ridge lines from any direction is to acquire sufficient altitude before crossing to avoid leeside downdrafts. If landing on ridge lines, the approach should be made along the ridge in the updraft or at an angle into the wind that is above the leeside turbulence. When the wind blows across a narrow canyon or gorge, it often will veer down into the canyon. Turbulence will be found near the middle and downwind side of a canyon or gorge. When a helicopter is being operated at or near its service ceiling a downdraft of more than 100 feet per minute (approximately) will cause the helicopter to descend. Although the downdraft may not continue to the ground, a rate-of-descent can be established of such magnitude that the helicopter will continue descending even though it no longer is affected by the downdraft. Therefore, the procedure for transiting a mountain pass is to fly along the side of the pass or canyon which affords an upslope wind. This procedure not only provides additional lift but also provides a readily available means of exit in case of emergency. Maximum turning space is available, and a turn into the wind also is a turn to lower terrain. Flying through the middle of a pass to avoid mountains often invites disaster. This is frequently the area of greatest turbulence and, in case of emergency, the pilot has little or no opportunity to turn back due to insufficient turning space.

19-16. Night Approaches to Unprepared Areas. (Not applicable to NVG/HH-53H operations.) Minimum en route altitude during night navigation both operationally and for training is 500 feet above the highest obstacle within five NM. Flights conducted on approved low-level surveyed routes may be conducted down to 300 ft above the highest obstacle within ½ mile. Conduct an area and site evaluation prior to the approach, much the same as under daylight conditions, provided adequate lighting is available from parachute flare illumination or aircraft lights. Under no circumstances will the low reconnaissance be conducted. Knowledge of the area in general, known hazards, and terrain features from briefings or charts, are determining factors on how to conduct the evaluation. Prior to the approach, brief all crew members on specific approach procedures, pilot's intention, significant terrain features, specific crew requirements such as scanning and other pertinent facts.

a. Determine actual altitude of the site. If a radar altimeter is installed and operative, fly directly over the site. At that time, cross-reference the radar altimeter with the barometric altimeter to confirm the elevation of the site. Size of the terrain features surrounding the site and the altitude flown over the site affect the accuracy of this check.

b. Use the type of approach best suited to the situation. Adjust pattern altitude accordingly, but in no case lower than 300 feet AGL on downwind (500 feet for H-53).

c. Establish final approach to approximate a normal approach commencing at no lower than 300 feet AGL (500 feet for H-53). The copilot calls out altitudes in 100-foot increments when above 300 feet AGL and 50 foot increments when below 300 feet AGL. The pilot cross-references instruments throughout the approach so as to reach approximately 200 feet AGL with an approximate ground speed of 30 knots. Airspeed and altitude normally are decreased to reach a hover height well clear of all obstacles. During the last 100 feet of the approach, limit rate of descent to approximately 300 FPM.

NOTE: Approaches at night generally will be flown with slightly slower rates of descent and closure rates than during daylight operations. As closure rates decrease, the time the aircraft remains in the unsafe area of the height velocity envelope increases. The pilot should remember the possibility of settling with power associated with slow forward speeds and high rates of descent.

d. The decision to make an approach to a hover or a touchdown is based upon power available and landing site condition. If at any time during the approach or hover conditions do not appear favorable or safe, initiate a go-around.

e. Throughout the entire approach use the radar altimeter, and cross-reference it with the barometric altimeter.

19-17. Landing Zone Lighting. (Not required for NVG operation.) Some type of landing zone lighting aid should be used to assist the pilot in locating and identifying the landing zone and making a landing at night. Lighting aids, including sophisticated terminal guidance systems, expeditionary lights, flare illumination, and field expedients, such as vehicle lights, flashlights, strobe lights, bonfires, and smudge pots, have been used successfully. Personnel on the ground will need to know whether the pilots will be using unaided vision or night vision goggles. Bright lights around a landing zone could cause problems for pilots utilizing NVGs. Likewise, if the landing lights are on an extremely dim setting, pilots using unaided vision would be unable to locate the landing zone. Regardless of the means employed, landing zone lighting should:

a. Be visible to the pilot.

b. Identify an area free of obstacles and safe for hovering and landing.

c. Employ three or more lights at least 15 feet apart to prevent autokinetic illusions.

d. Provide orientation along an obstacle-free corridor for landings and takeoffs.

19-18. Landing Zone Lighting Patterns. Since a variety of landing zone lighting patterns are in use, the pilot should anticipate diversity in lighting patterns when participating in joint and/or combined operations. Figures 19-7 thru 19-9 present examples of lighting patterns.

a. The lighted T pattern can be effectively used for all aircraft. Lights at the head of the T must be at least five paces apart and the lights in the stem must be at least 10 paces apart to indicate the windline. The head of the T should be positioned to the windward side. Set up this fashion, the lighted T provides visual cues to determine the correctness of the glide angle by observing the apparent distance between the lights in the stem of the T (figure 19-7). If the lights in the stem appear merged into a single light, a shallow glide angle is indicated. If the lights in the stem appear to increase in distance apart, the approach is becoming steeper. Approach path lineup corrections can be made using the stem of the T. If the stem points to the left, the helicopter is right of course and should correct to the left; if it points to the right, the helicopter is left of course and should corrected to the right. The overall advantages of the T are:

(1) Provides excellent acquisition of the landing zone from a distance.

(2) Spacing of lights at the head of the T simplifies identification of approach direction.

(3) Provides glide slope, course alignment, and wind drift information.

(4) Provides at least two reference lights at all times to decrease the chance of special disorientation on approach and final landing.

b. The Y light system is an excellent means of identifying landing zones. (Other marking systems are identified in AFM 3-5, USREDCOM 10-3, OR FM 31-20.) Lights for the inverted Y should normally be spaced IAW Figure 19-9. The following guidance applies:

(1) The direction of the approach is into the open end of the Y.

(2) When compatible with the approach path, wind direction will be along the stem of the Y.

(3) The touchdown area is outlined by the triangle formed by the three lights marking the open end of the Y.

c. Surface vehicle headlights are an excellent lighting source providing they do not blind the pilot during the approach. If used, the vehicle should be placed to the pilot's right and the lights directed toward the point of intended landing.

d. Landing zone approach/departure clearance criteria should comply with Figures 19-10 and 19-11 for tactical night operations training. See applicable 3-1.

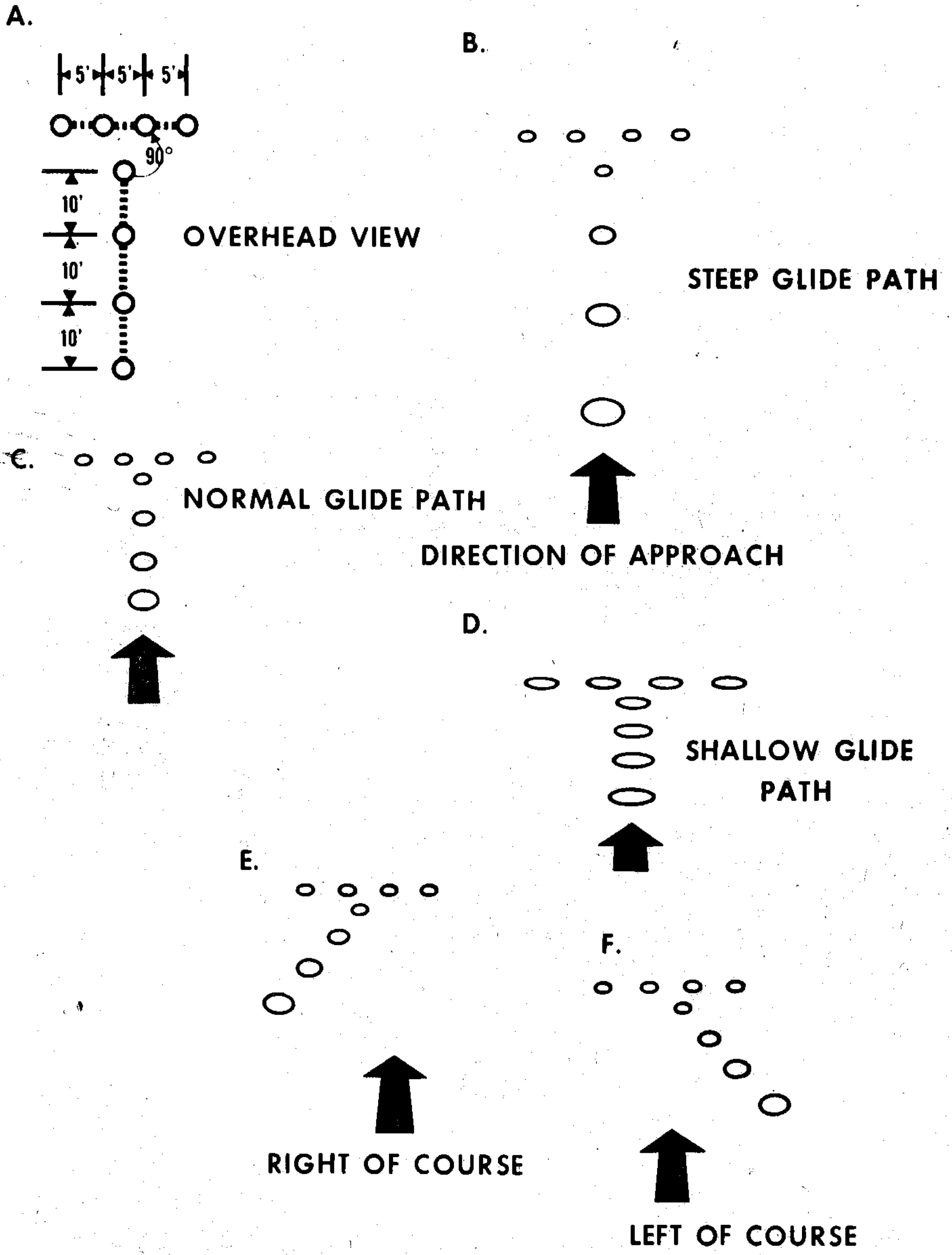


Figure 19-7. Approach to Lighted T Pattern in Landing Zone.

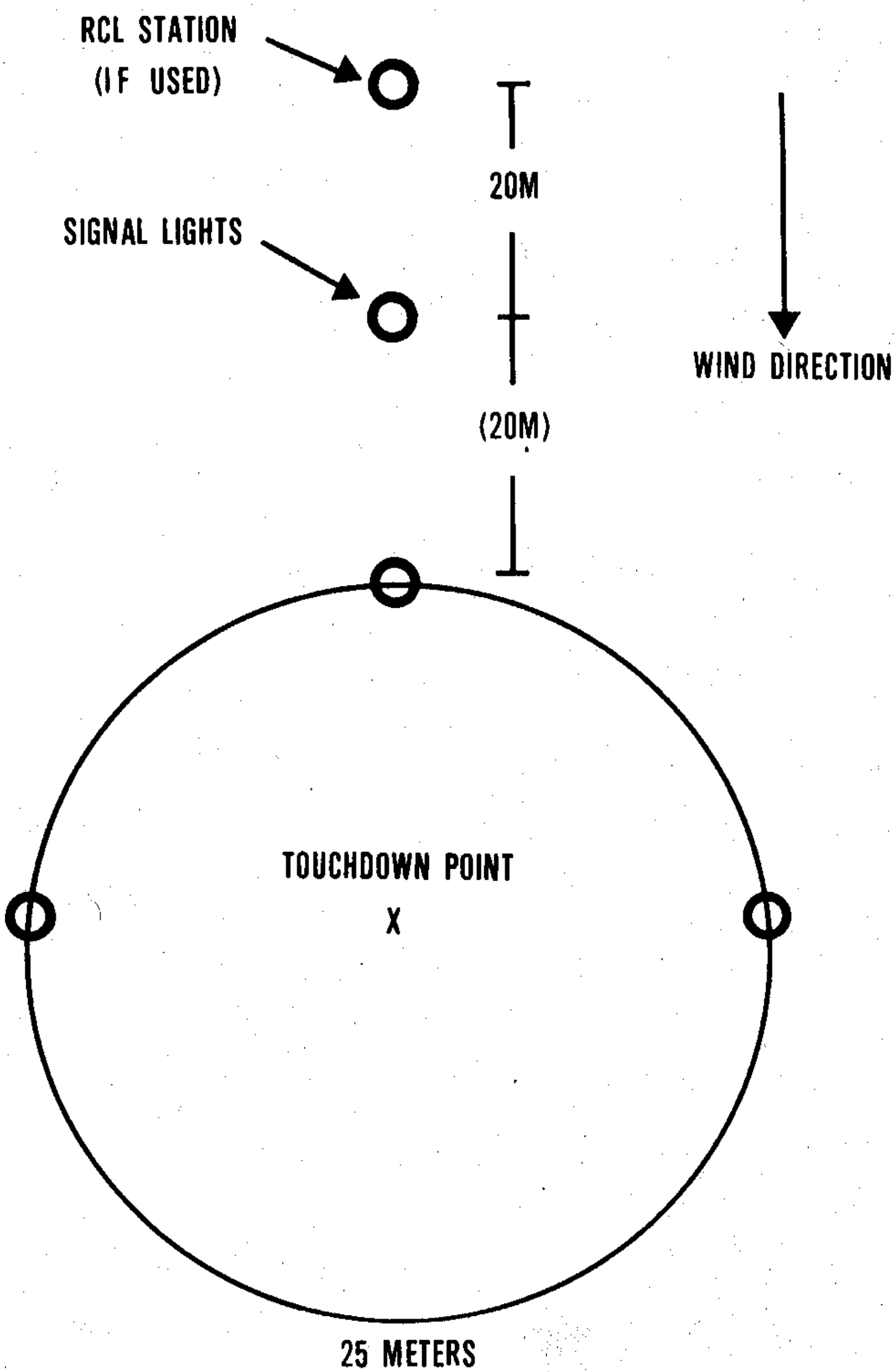
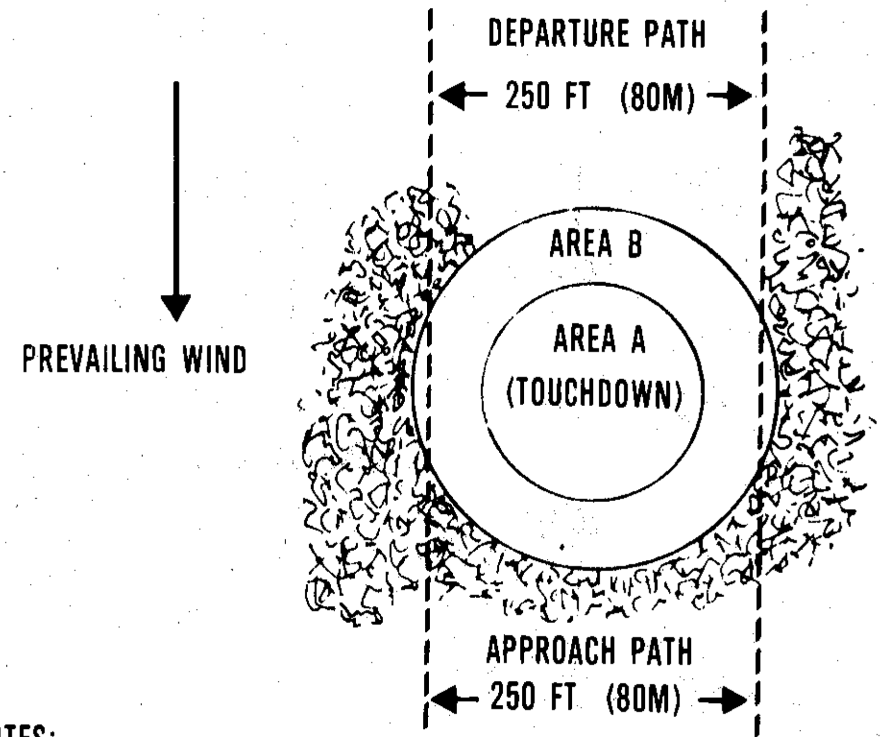


Figure 19-8. Typical Helicopter Landing Zone Pattern for Night Operations - Inverted Y.



NOTES:

1. AREA A - 170 FEET (50M) IN DIAMETER, CLEARED TO GROUND LEVEL
2. AREA B - 65 FEET (20M) IN WIDTH, CLEARED TO WITHIN 3 FEET (1 METER) OF GROUND

Figure 19-9. Helicopter Landing Zone (Night).

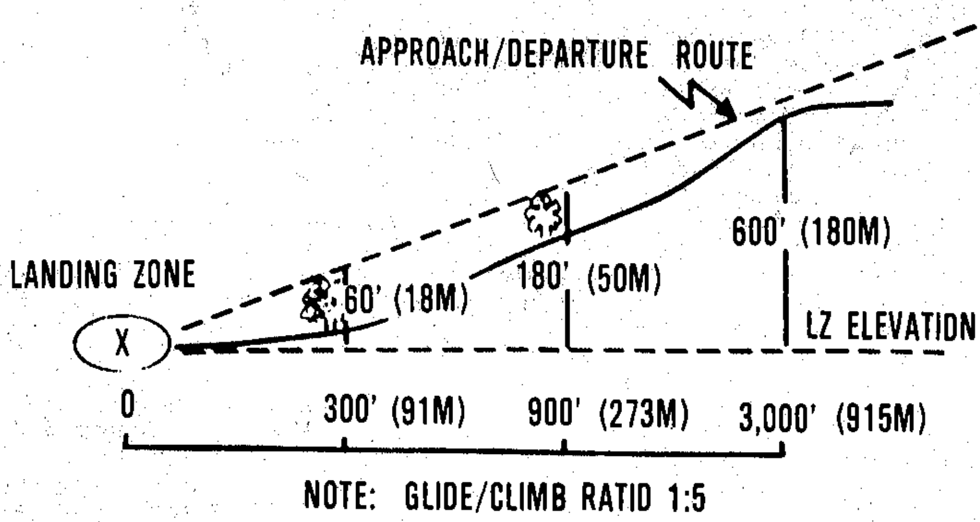


Figure 19-10. Approach/Departure Path Clearance Helicopter.

Chapter 20

PREPARATION AND MANUAL LAUNCH OF PYROTECHNICS

20-1. General. This chapter covers the preparation and manual launch of pyrotechnics. TO 11A10-24-7, TO 11A10-26-7, and TO 11A8-5-7 contain the technical data on pyrotechnics, and AFOSH Standard contains safety procedures and requirements. On all flights have asbestos gloves readily available and helmet visor in use when deploying pyrotechnics.

CAUTION: Prior to arming pyrotechnics inflight, a door will be open to permit emergency jettisoning.

20-2. Parachute Flares. Use parachute flares to illuminate areas for emergency crash landing, ditching, landing, hovering, dropping of supplies, and/or recovery equipment. Prior to arming pyrotechnics inflight, open a door to permit emergency jettisoning. If flares are to be used over land or over flammable areas, insure they are launched at a sufficient height to allow for burnout prior to impact.

a. M8A-1, Aircraft Parachute Flare:

(1) Operation. Pull the tear strip and remove the shipping cover. Attach the lanyard to the swivel loop of the hangwire. Launch flare parachute end up (attachment end) to assure opening. Be sure lanyard does not foul.

(2) Special Precautions. Drop from a minimum altitude of 2,500 feet above the surface to assure complete burnout before impact. Be sure lanyard does not foul. A pull of only 12 pounds on the lanyard after the flare is armed will initiate the fuses.

b. The LUU-4/B is a 1.6 million candlepower flare which is activated by a 30-pound pull on a lanyard during launch from an aircraft. The flare descends approximately 1,500 feet while burning. Approximate burn time is three minutes. Because the pyrotechnic candle consumes the flare case, the parachute may tend to hover during the last minute of burning time. Approximately 10 to 20 seconds prior to candle burnout, the heat of the burning illuminant activates the cable fitting explosive bolt, releasing a parachute shroud line and collapsing the parachute, allowing the flare to fall quickly to the ground, clearing the air of debris. **CAUTION:** Care should be taken not to pull parachute shroud lines. Any pull in excess of 52 pounds will cause flare ignition. During flare handling, should the pull plug be accidently pulled and the cover assembly released, that portion of the parachute that comes out of the case may be stuffed back into the case and the cover assembly safely hand held and taped onto the flare housing. The flare is then marked for disposal.

c. LUU2A/B, Aircraft Parachute Flare: (Two crewmembers are required in the cabin when deploying parachute flares.)

(1) Operation. Set desired feet of fall in flare timer end cap.

NOTE: A setting of 500 feet sets a time delay of 6.3 seconds. A launch altitude of 3,000 AGL provides light at 2,500 AGL. The flare descends approximately 2,500 feet during burning. The snap hook in the lanyard package of the LUU 2A/B shipping container may be used for the flare attaching end. Attach a 10-foot lanyard, secured to a tie-down ring near the exit to the time set knob. Insure that static line is clear of all extremities and/or equipment before dispensing flare. Flare launcher should coil excess static line and hold against the flare body. Toss flare overboard from the exit with ignition end out first. (Ignition end opposite from timer end cap.) A force of 30 to 35 pounds is required to extract the timer dial knob and drogue cover strip. The knob and cover strip remain with the static line. Retrieve the static line and dispose of all residue.

(2) Special Precautions:

(a) If the timer set knob is accidentally pulled and the timer cycle starts, the timer and release mechanism may be forced back onto the flare housing to prevent ejection of the timer and release mechanism. When the timer completes its cycle, tape the mechanism on the flare housing and mark for disposal. If the timer is ejected from the flare, that portion of the parachute that comes out of the housing may be stuffed back into the housing, taped, and marked for disposal.

(b) Pre-ignition of Flare: JETTISON FLARE OR CONTAINER IMMEDIATELY.

WARNING: In the event of flare ignition, an attempt will be made to jettison the flare. In the event of candle ignition, intense light, heat and lethal gas will be experienced. Adequate respiratory, eye, and hand protection will be sought as soon as emergency permits. Flare suppression will be attempted as a last resort.

(c) FLARE BREAKAWAY FAILS TO RELEASE:

1. Static Line - CUT.
2. Pilot - NOTIFIED.

d. Marker Location (Ground-Marine), LUU-10/B:

(1) Physical Description. The LUU-10/B marker consists of two major subassemblies. The upper case assembly contains the deployment and flotation systems. This section contains: deployment lanyard cables, end cap, pullout cord, parachute, candle riser cable, igniter, compressed gas cartridge, flotation collar, actuating devices for the igniter and gas cartridge, and a manually extractable safety pin to prevent actuation prior to use. The safety pin is accessible from the outside, and the olive drab tape which circumscribes the upper case. The lower case assembly (approximately the lower two-thirds of the marker) consists of the outer container, inner insulation, and pressed candle. The candle assembly contains the pyrotechnic for producing the smoke. The assembly contains approximately 10 pounds of smoke composition and 15 grams of igniter composition.

(2) Functional Description. The LUU-10/B marker may be hand launched from the UH-1N, HH-3, HH-53, and HH-60A helicopters and automatically dispensed from the HC-130. Design launch velocities are 0 to 200 knots at altitudes of 200 to 3000 feet. The deployment lanyard becomes taut when the marker separates three feet from the launch point. The end cap is pulled out by the deployment lanyard, the marker separates an additional 15 feet, feeding out the pullout

cord. The parachute container is pulled out of the marker when the pullout cord becomes taut, after the parachute is completely extended and candle riser tension actuates the inflation and igniter mechanisms, inflating the flotation collar and igniting the candle. Upon complete extension of the parachute, risers, and lanyards during deployment, the tension force on the deployment lanyard and the marker separates from the aircraft. Upon separating from the aircraft, the marker descends until impact on land or water. After impact, the marker continues to burn, emitting a red smoke signal for a period of 20 minutes with a minimum risk of igniting adjacent vegetation during operation.

20-3. Manual Parachute Flare Launching Procedures:

a. Obtain wind direction and velocity from the most reliable source (i.e., forecast, surface indications, doppler, etc.), and verify the information. The flare helicopter must establish precise patterns prior to committing the recovery helicopter into the target area. Constantly monitor the winds throughout the operation to preclude a wind shift from drifting the flares into the recovery helicopter.

b. Secure mission flares to the cabin floor with cargo tie-down straps.

c. Station the helicopter Flight Engineer (FE) at the door to deploy the flares. Other personnel may uncrate and supply the flares to the FE as required, and assist in keeping the cabin clear of flare crating material. The forward edge of the cargo door (the bottom and aft edges of the crew entrance door sill) may be taped if necessary to preclude chafing of the flare lanyard during repeated drops.

d. All crewmembers participating in the flare launching will wear a restraining harness adjusted to prevent exit from the aircraft. The crewmember deploying the flares will wear flying gloves and have a pair of asbestos gloves readily available in case of fire. All other personnel in the cabin not performing duties will be seated with seat belts fastened.

e. Drop two flares on each pass, one immediately after the other, to assure continued illumination in the event of a dud. On training flights, one flare may be dropped with another readily available for immediate deployment. Attach the flare lanyards to the cabin floor tie-down ring just aft of the personnel door. Limit lanyards to less than 10 feet to prevent fouling on the skids or in the main landing gear well after flare deployment. Lanyards will be locally manufactured, preferably of nylon tape. Use snap hooks of proper size to fit the flare and tie-down ring.

NOTE: Retrieve static lanyard immediately to prevent possible damage to aircraft.

20-4. Parachute Flare Drop Pattern:

a. Upon locating the target, the recovery helicopter will establish the pattern direction (left or right) into the wind. The flare helicopter will establish a pattern which will keep the pattern of the recovery helicopter clear of descending flares. Normally, the flare helicopter will fly a right-hand pattern and the recovery helicopter will fly a left-hand pattern (see figure 20-1).

b. Fly the flare pattern at a minimum of 3000 feet AGL (2,500 feet for M8A-1/LUU-4/B), 70 KIAS or 90 KIAS, with an absolute maximum of four minutes between drops (three minutes for M8A-1/LUU-4/B).

c. Estimate drop heading and timing from target to drop by use of figure 20-1 and adjusted as necessary.

d. The pilot establishes the flare pattern and advises the FE of the drop timing. The FE accomplishes the flare drop checklist and advises the pilot when complete.

e. The FE advises the pilot when over the target. The pilot not flying will start the timing and then make a countdown over the interphone from five seconds to "DROP NOW." The FE notifies the pilot when the flares are deployed and their conditions (i.e., dud, streamer, or good light one and/or two). The FE advises the pilot when it is clear to turn.

f. Notify the recovery ship any time a malfunctioned flare is dropped (i.e., good chute, no flare). The recovery ship will remain clear of the flare line until the flare's position can be determined.

g. The recovery helicopter will advise the flare ship, as necessary, on corrected drop heading and timing to insure sufficient illumination during the hoist recovery; i.e., "Correct five degrees left and time to drop of 18 seconds."

h. Alternate Flare Drops Pattern. Due to the shorter burn time of some parachute flares, an alternate flare drop pattern may be required. A parallel pattern 500 feet abeam the recovery helicopter's pattern should be flown. Timing is the most difficult aspect of this pattern. Timing can be adjusted by turning abeam the hover point; however, if high winds prevent this, a separate pattern based on timed turns may be required. When using this type of pattern, consideration should be given to dropping a marker smoke in the general area of your release point to assist in determining a more exact release time. This pattern is not as precise as the established flare drop pattern, but it does allow for a safe means of deploying parachute flares without endangering the recovery helicopter.

20-5. AN-MK 6 MOD 3; Aircraft Smoke and Illumination Signal:

a. Use. This signal provides long burning surface smoke and illumination for day or night use. It is used to mark sightings at sea, make sea evaluations, marking a sea lane for night water landings or wind drift determination prior to deploying personnel. It may be used to provide smoke on land surfaces if a fire hazard does not exist. Burn time is approximately 40 minutes.

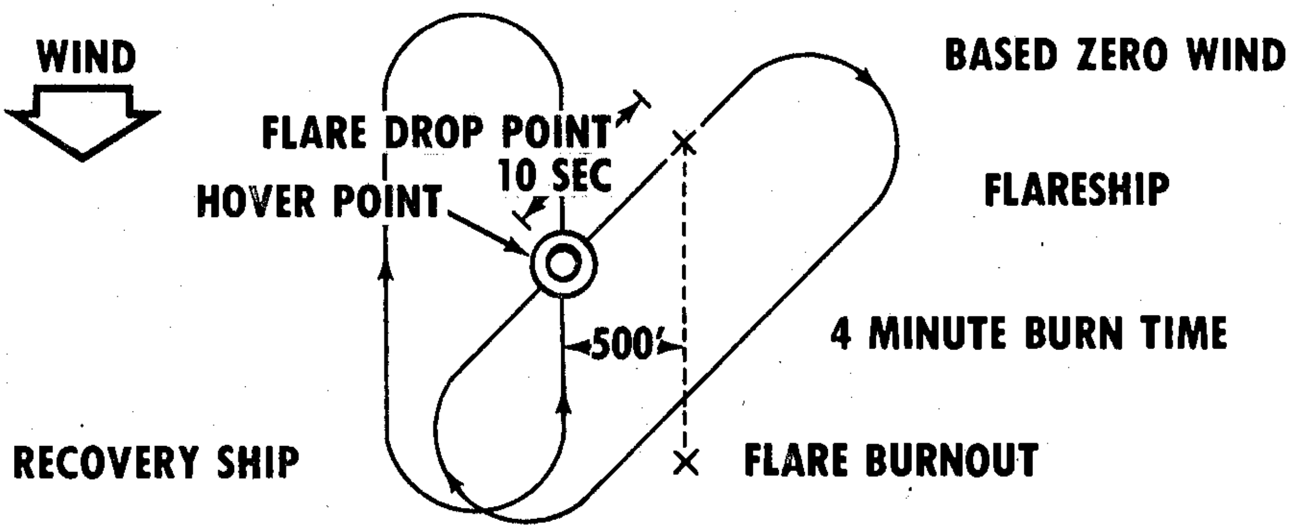
b. Operation. Prior to launching the signal, remove the adhesive tape covering the pull ring.

NOTE: Do not remove the four square patches of adhesive tape covering the metal caps in the holes from which flame and smoke issue after ignition of the candle. At the time the signal is launched, actuate the pull-type igniter either by hand or by a lanyard attached to the aircraft which sharply pulls the ring attached to the friction wire. This signal may be deployed from altitudes up to 5,000 feet AGL.

WARNING: The illumination and smoke signal must be launched immediately after the igniter has been actuated.

c. Special Precautions. Do not use a static line or lanyard to actuate the smoke signal when used for wind determination prior to personnel deployment. All safety-armed unexpended pyrotechnics: return them to

FLARE DROP PATTERN



	DROP HEADING AND TIME	70 KIAS	90 KIAS
AVERAGE W/VEL	**HEADING CORRECTION**	**TIME/SEC**	**TIME/SEC**
0	045°	10	10
5	020°	20	15
10	015°	40	30
15	010°	60	45
20	008°	90	70
25	006°	120	90
30	004°	180	120

NOTE: 90 KIAS RECOMMENDED FOR WINDS OVER 15 KNOTS

Figure 20-1. Flare Drop Pattern.

original containers, and turn them over to the responsible personnel upon completion of the flight.

20-6. AN-MK 5, MOD 4; Aircraft Smoke and Illumination Signal:

a. Use. This marker was designed to be dropped from aircraft over water (salt and fresh) during day or night operations. It provides a flame 12-15 inches in height, accompanied by white smoke for a period of approximately 12 minutes.

b. Operation. Launch the signal nose down from the exit. No lanyard is required. Minimum recommended altitude and airspeed for launch is 300 ft AWL and 65 KIAS. The signal has a delay time of 22 seconds after impact.

20-7. MK 25, MOD 3; Marine Location Marker:

a. Use. This marker was designed for day or night use for any and all sea surface reference point marking purposes which call for smoke and flame in the 10-20 minute range.

b. Operation. To activate the marker, rotate the base plate from the safe to the armed position to allow the battery cavity ports to be opened. Open the ports by pressing the two brass colored port plugs into the battery cavity using the thumb and forefinger. A one-

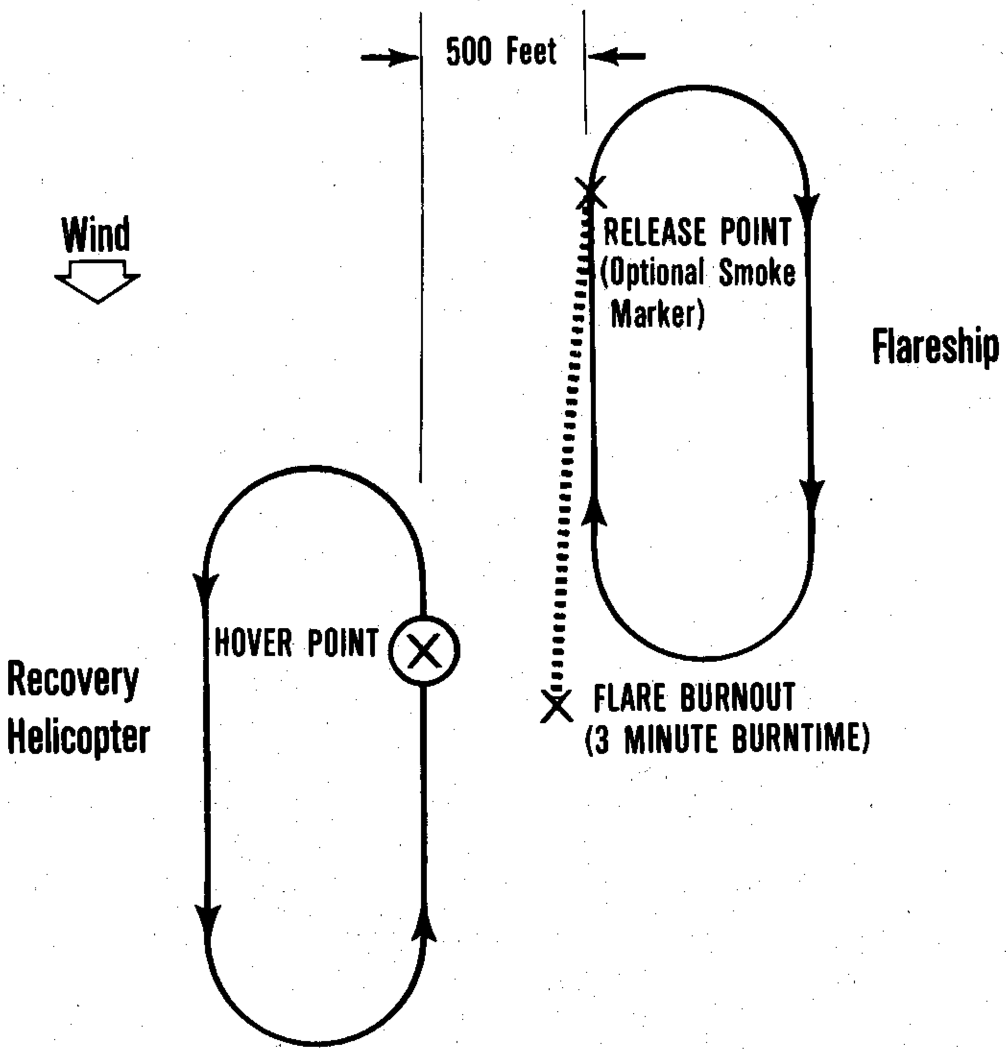


Figure 20-2. Alternate Flare Drop Pattern.

pound force is required for plug removal. This device is considered to be a sealed unit until its base plugs (one or both) have been pushed in. For use in fresh water, open only one port and pour in approximately one tablespoon of dry table salt (crushed salt tablets may be used).

CAUTION: Use only dry salt.

WARNING: Do not return armed markers to storage. To preclude needless waste of flares, do not push in the brass plugs until committed for deployment.

WARNING: When required, retrieve the expended flare from the water with asbestos gloves and place the burned end down in a metal container filled with water. Transport flares to a point where EOD can receive them. The bucket, water and flares must be transported as a unit. Do not pour out the water as it may be contaminated with white phosphorous capable of spontaneous reignition.

20-8. MK 1, MODS 2 and 3; Marine Location Marker:

a. Use. This marker is designed to produce a daylight reference point on ocean's surface in the form of a chrome yellow dye slick. It is used to mark sightings, as a signal in search and rescue operations, or as a hover reference point. Dye persists for approximately 30 minutes.

b. Operation. Remove marker from its shipping container. Grasp the signal firmly in one hand, holding the safety lever firmly against the marker body while the cotter pin is removed and until the marker is launched. For launching in a hover, throw the marker forward and down from the right cabin door when directly over the survivor.

c. Special Precautions. Do not remove the safety cotter pin from the firing mechanism unless the marker is held properly. The grenade-type firing mechanism must be held so as to assure that the safety lever is secure against the body of the marker. Only a small movement of the release lever is required to free the striker.

WARNING: Do not attempt to replace the safety cotter pin after it has been removed. Once removed, the marker must be expended.

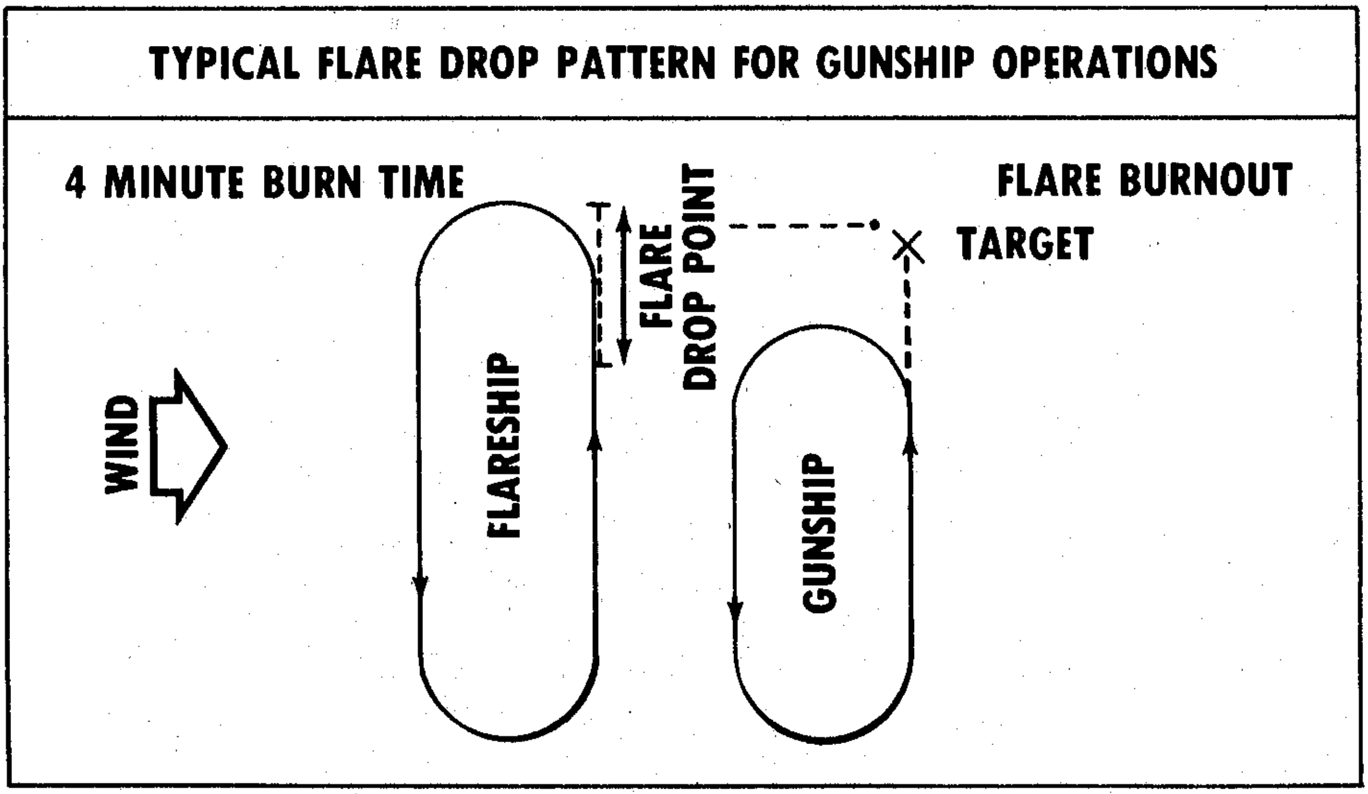


Figure 20-3. Gunship Flare Drop Pattern.

20-9. AN-MK 59; Marine Location Marker:

a. Use. This marker is designed to produce a daylight reference point on the ocean's surface in the form of a fluorescent green dye slick. It is used to mark sightings or as a signal in search and rescue operations. Dye persists for approximately two hours.

b. Operation. Open the cardboard container and remove the barrier line and completely open the end of the barrier bag overpack. When ready for deployment, invert the bag and allow the dye bag to free-fall from the protective bag. Upon striking the surface, the plastic bag ruptures, releasing the dye.

NOTE: Due to the fragile nature of the plastic bag containing the dye, it should be left in the barrier bag until deployment.

20-10. AN—MK 13, MOD 0; Marine Smoke and Illumination Signal:

a. Use. This signal is a combination distress signal for use under day or night conditions. It may be used to signal search aircraft and to indicate wind direction for paradrops or aircraft landings. Smoke or flame time is approximately 20 seconds for each end.

b. Operation. Determine which end of the signal to use. (Orange smoke for day and flare for night.) The flare end of the tube can be identified by a series of embossed projections extending around the case approximately ¼-inch below the closure. Remove the paper cap and give a quick pull on pull ring which will come away from the can, thereby igniting the composition.

NOTE: If unable to remove the soldered cap in this manner, bring the pull ring down over the rim of the can and press down using the ring as a lever to break the seal. Hold the signal at arm's length at an angle of about 30 degrees upward to prevent hot drippings. Signal may be restored to its original packing after cooling and retained for use of the opposite end.

c. Special Precaution. Never attempt to ignite both ends of the signal at the same time.

20-11. AN-MK 8; Smoke Grenade (White, HC Hexachloroethane):

a. Use. This smoke grenade is used for daytime ground and ground-to-air signaling of search aircraft to indicate wind direction or for prearranged visual communications. Smoke time approximately three minutes.

b. Operation. To launch, grasp the signal firmly in one hand holding the safety lever firmly against the grenade body while the cotter pin is removed and until the grenade is launched.

c. Special Precautions. Do not remove the safety cotter pin from the firing mechanism unless the smoke is held properly and is ready for launching. The grenade-type firing mechanism must be held so as to assure that the safety lever is secure against the body of the smoke until it is launched. Only a small movement of the release lever is required to free the striker igniting a 1.2 to 2-second delay element of the fuse.

WARNING: Do not remove the safety pin until just prior to deployment. Once prepared for use, the smoke must be expended.

20-12. MK 18; Smoke Grenade (Red, Green, Yellow, or Violet). This grenade is used for the same purpose as the AN-M8. Its operation and precautions for handling are identical. Smoke time approximately one minute.

20-13. Very Pistol:

a. Use. These signals provide day or night identification or signaling from aircraft or surface. Additionally, when used with the Mark 50, Mod 0 (IRCM Flare), it provides an infrared threat decoy designed to divert heat-seeking weapons (missiles) away from the helicopter.

b. Operation. Insert and lock the cartridge in the breech of the pistol. Once inserted and locked in the breech, the flare is launched by pulling the trigger. When used inflight for diverting infrared weapons, the following procedures apply:

(1) Load flares into bandolier.

NOTE: Mark 50, Mod 0 flares are shipped in hermetically sealed containers and should not be opened unless actual use is anticipated. Once opened, the one year shelf life begins.

(2) Install mounting bracket on the aircraft.

(3) Attach Very pistol to the mount.

(4) Load the Very pistol (inflight prior to entering the threat area).

NOTE: Flares will not be loaded until Very Pistol is attached to the mount and must be unloaded prior to detaching from the mount.

WARNING: The Very Pistol is cocked and ready to fire at all times when the breech is closed.

(5) Don the bandolier or store it immediately available at the firing position.

(6) Upon detection of a missile launch, fire the appropriate flare in a manner that will draw the missile away from the aircraft. Do not fire at the missile.

NOTE: As soon as the pistol is fired, immediately reload to maintain a continuous defensive capability. IRCM kit contents are outlined in 23 AF 50-3, 55-13 and 57-1. When these kits are aboard the aircraft, the provisions of TO 11-1-33, and TO 1-1-4 apply. During hands-on training with the IRCM kit, live rounds will not be loaded. Expended cartridges may be used to practice loading and reloading of the pistol.

c. Special Precautions:

(1) Do not fire flares if fuel siphoning is observed or fuel is being jettisoned.

(2) The smoke and fumes of the Mark 50, Mod 0 flares are highly toxic. If a flare is expended in a confined space, don protective masks immediately.

(3) If an aircraft signal fails to fire:

(a) Keep the pistol pointed in the intended direction of fire.

(b) DO NOT OPEN THE BREECH.

(c) After five seconds, make two attempts to fire the flare.

(d) If the signal still fails to fire, wait 30 seconds before removing the signal from the pistol.

Chapter 21

PERSONNEL/EQUIPMENT DELIVERY

SECTION A—PERSONNEL DELIVERY OPERATIONS

21-1. General. There is seldom a tactical requirement for airdropping personnel from helicopters. The procedures in this chapter are provided for those instances where airdrops are required. Personnel delivery operations refer to operations where the unloading of personnel is accomplished from an aircraft in forward flight. Personnel will exit the aircraft on command of a qualified jumpmaster or jumpmaster under the supervision of an instructor after clearance is received from the aircraft commander.

21-2. Mission Briefing. A thorough briefing will be given by the mission commander. All aircrew members and the jumpmaster will attend. Insure a passenger briefing is given. In addition, the following items will be covered:

a. Use of restraining devices.
b. Use of doors and/or ramps.
c. Movement in cargo compartment.

21-3. Personnel Parachute Drop Zone Markings:

a. Placement and type markings for both night and day drops will be as outlined in AFM 3-5, FM 31-20, USREDCOMM 10-3, ARRSR 55-11, and this regulation. Command emphasis must be focused to insure that the DZ controllers and aircrews are fully coordinated on type markings used, configuration on the DZ, method of identification/authentication and release point.

b. For training or exercise SOF missions, a "Regular L" is normally erected. The helicopter flies up the base of the "L" and the jumpers exit when abeam the flanker panels. When using this marking system, the helicopter does not normally fly the 50 meter offset.

21-4. DZ Identification/Authentication:

a. Surface-to-Air:

(1) The primary method of confirming DZ identification is by radio contact. The display of a specified target panel/light/shade pattern during the scheduled time block (from two minutes prior to two minutes after a scheduled (TOT) and oriented to the approach azimuth/track at the specified geographical location may serve as DZ identification and authentication.

(2) An additional code light or smoke signal may be used for identification/authentication.

(3) All authentication requirements indicated on the mission request must be met or the drop will be aborted.

b. Air-to-Surface. The aircraft is identified/authenticated by arriving in the objective area within the specified time frame on the designated approach azimuth/track.

21-5. Personnel Parachute Delivery Deployment Abort Procedures. When conditions are not safe for the drop or if the drop is aborted for any reason, the following procedures will apply: Any crewmember will notify the aft compartment crewmembers by interphone using the words "No drop." The crewmember will acknowledge. The jumpmaster must be notified immediately upon determination of the delivery abort.

21-6. Wind Limitations for Personnel Parachute Delivery:

a. ARRS Personnel Delivery—Land (Training)
(1) Open Field Surface winds: 15 knots
(2) Tree Area Surface winds: 20 knots

b. ARRS Personnel Delivery—Water (Training): 25 knots

c. SOF Personnel Delivery—Land (Training): Wind limitations will be determined by jumpmaster.

d. SOF Personnel Delivery—Water
(1) Surface winds: 25 knots
(2) Sea state: 3 foot high (chop)
4 foot high (swell)

NOTE: Drop altitude wind restrictions do not apply during free-fall operation. Exception: The drop altitude wind restrictions does apply to the opening altitude for HALO operations.

21-7. Altitude/airspeed limitations for personnel parachute delivery (Training):

a. Minimum pattern altitude: 1500 ft AGL/AWL (1000 ft for SOF when required for contingency training)

b. Delivery airspeed: 60-90 KIAS (specific airspeed must be briefed prior to take-off)

NOTE: Static lines will not be hooked up until the aircraft is 1000 feet AGL.

21-8. Personnel Parachute Delivery Positions On-Board the Aircraft:

a. H-53—Standing on ramp.
b. H-3—Standing at main cabin door.
c. H-1/H-60A—Sitting on floor at edge of cargo doors. From either/both sides (if only one side is used it should be the side opposite the tail rotor.)

21-9. Aircraft Restrictions:

a. H-53—Tail skid must be retracted.
b. H-3—Main landing gear must be up.
c. H-1/H-60A—Cabin door on tail rotor side should remain closed unless delivering parachutists from both sides.

NOTE: H-3/53—To avoid the static line from becoming entangled with the jumper, the static line will be accordian folded and held until the weight of the jumper pulls the line free.

H-1/H-60A—To avoid the static line from becoming entangled all excess static line will be restowed in the jumpers parachute static line retaining bands.

21-10. Aircraft Preparations:

a. The anchor line will be connected through the floor mounted tie-down rings as depicted in figures 21-1 through 21-4.

b. During preflight the crew will ensure the following actions are accomplished:

(1) All protruding objects and sharp edges in the vicinity of the exit doors are removed or taped.

(2) The anchor line cable is secure.

(3) A seat belt is provided for each parachutist.

(4) Safety harness is provided for the aircrew safetyman and jumpmaster (if jumpmaster is not going to jump).

(5) Troop seats will be configured to avoid damage or entanglement.

Helicopter Personnel Deployment Anchor Line Cable

	Length	Test, Inspection, and Documentation
H-1N/F/H	9 ft 2 in	The standard anchor cable is ¼" in diameter tested to 6400 pounds with swaged cable eye and forked terminals, fastened with steel bolt and lock nut with safety pin. Anchor cables will be fabricated and maintained IAW TO 1-1A-8. Manufactured cables will have the date of initial manufacture and weight testing capacity (2,500 pounds) permanently marked on the forked terminal. Cables will be visually inspected each time the cable is installed for jumping. Cables showing excessive wear, corrosion, or more than three broken strands per inch br2e removed from service. Cables will be weight tested to a 2,500 pound capacity within each 12 calendar month period. (Example: Cables weight tested on 1 January will be due weight testing by 31 January the following year.) Documentation of annual weight testing will be accomplished on a DD Form 1574 and attached to the cable at all times.
H-3	10 ft	
H-53	17 ft 5 in	
H-60A	11 ft 8 in	

21-11. Personnel Parachute Delivery Procedures. These procedures apply to all aircrews participating in the delivery of personnel by parachute. Coordination between the AC and jumpmaster is the key to success. Details for delivery patterns are provided in ARRSR 55-11, Army Training Circular 57-1, Field Manual 57-1, MACR 3-3, and TM 57-220. The non-tactical personnel parachute delivery pattern/procedures are depicted in figure 21-5. All training will be conducted at drop zones that have been surveyed and approved.

21-12. Communications:

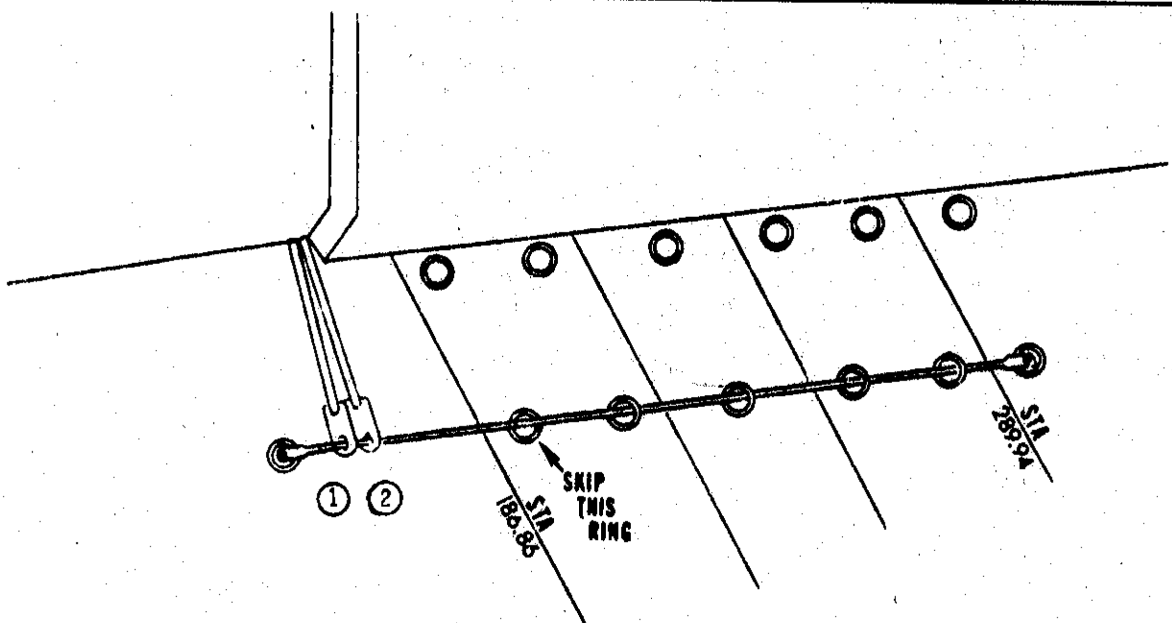
a. Air to Surface. Radio contact with the DZ is normally required. This requirement is waived if:

(1) Lost radio procedures are prebriefed.

(2) Red smoke grenades or flares are available to the DZ control party.

(3) Marker panels and DZ markers are visible to the pilot or jumpmaster when inbound to the DZ.

b. Aircrew communication procedures:



1. First Jumper's Hookup Point
2. Second Jumper's Hookup Point

Figure 21-1. H-3 Anchor Line Cable.

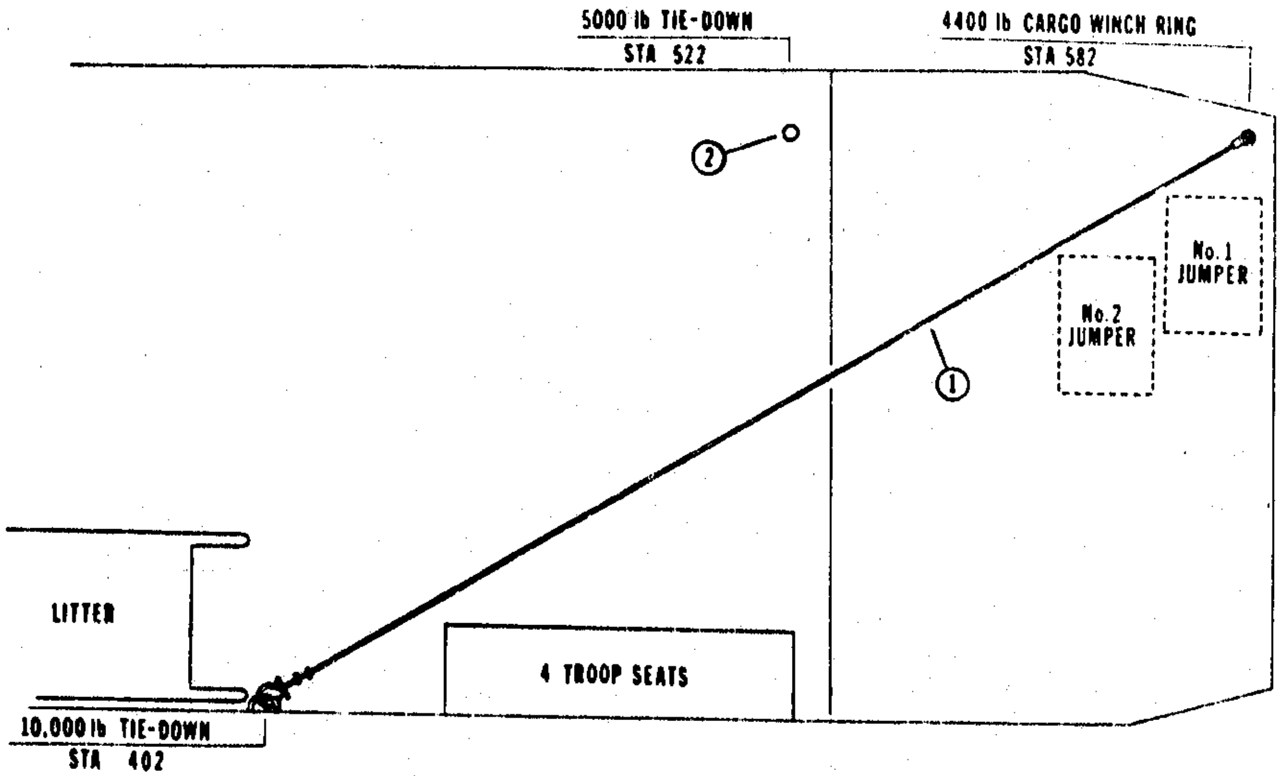
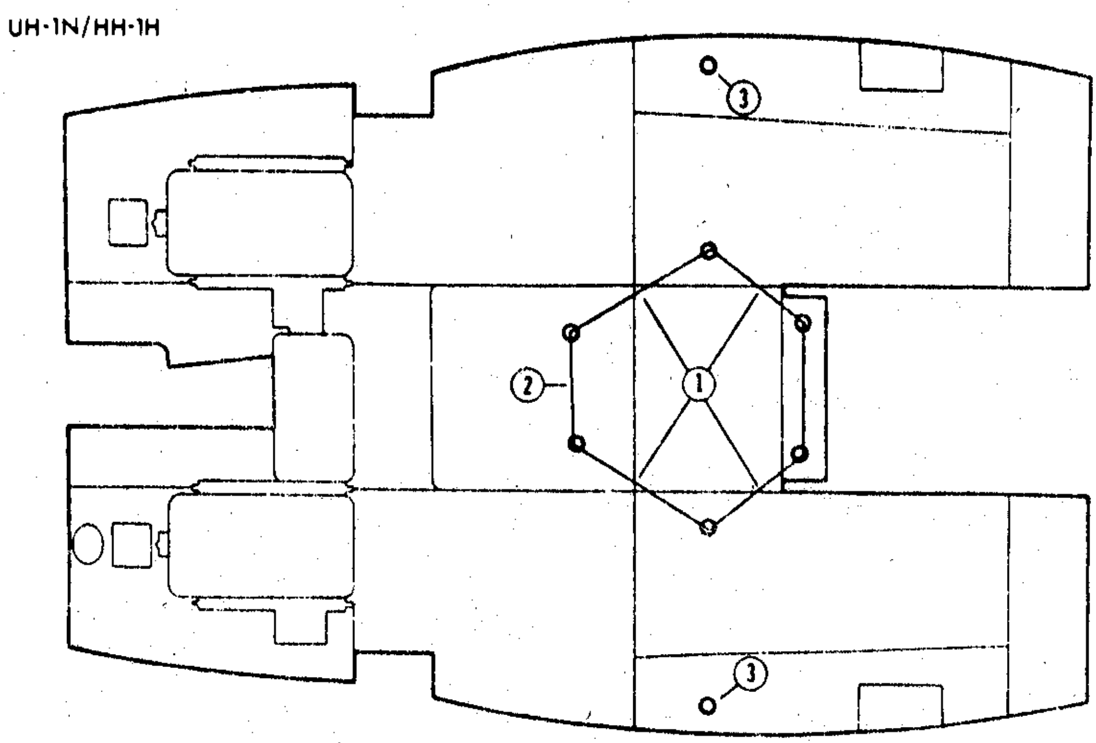


Figure 21-2. H-53 Anchor Line Cable.



1. Jumper's Hookup Points
2. Cable Union Point
3. Spotter Chute Anchor Point (Tie-down Ring)

Figure 21-3. UH-1N/H-1H Anchor Line Cable.

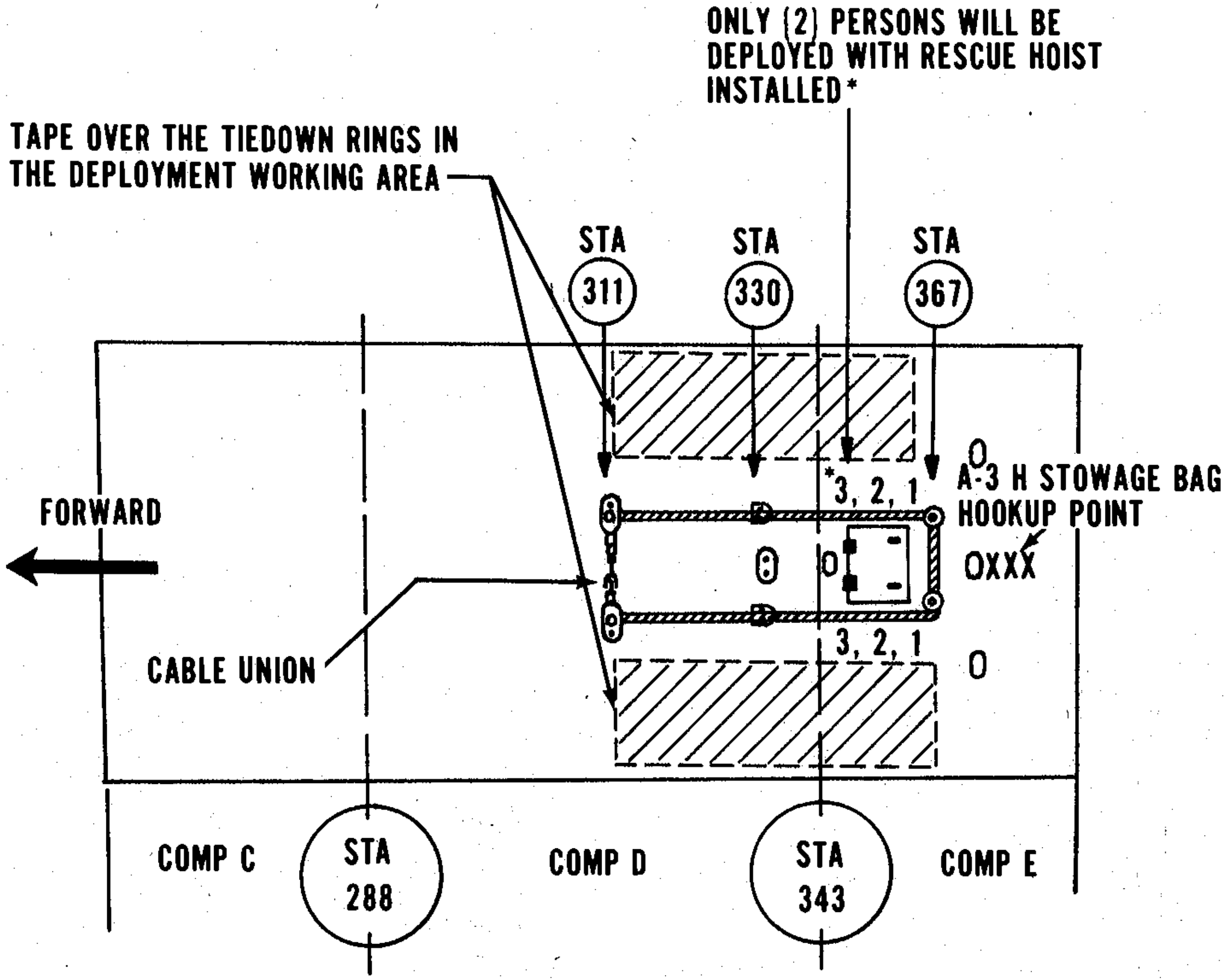


Figure 21-4. UH-60A Anchor Line Cable.

(1) Voice terminology—The accuracy of a personnel delivery mission depends on the coordination between crewmembers. The pilot will normally give 10 minute, 5 minute and 1 minute warnings prior to reaching the drop zone. The pilot will call 30 seconds prior to drop and will acknowledge "clear to drop" after he receives the response "safetyman check completed." The decision whether or not to jump rests with the aircraft commander. The jumpmaster will acknowledge all calls from the pilot (while on intercom) The jumpmaster provides heading corrections on final approach using the following standard terminology:

(a) "Steady." Present course is satisfactory.

(b) "Right." Change direction to the right five degrees.

(c) "Left." Change direction to the left five degrees.

(d) "Right/left degrees." Change direction as indicated. This direction is utilized to direct changes in excess of five degrees.

(e) "No Drop." No drop will be made due to unsafe or unknown conditions or unsatisfactory positioning over target.

(f) "Jumper away, clear to turn." The pilot is clear to turn and begin the next pass or observe the results of the drop just accomplished. The safetyman retrieves all deployment bags prior to issuing a clearance to turn.

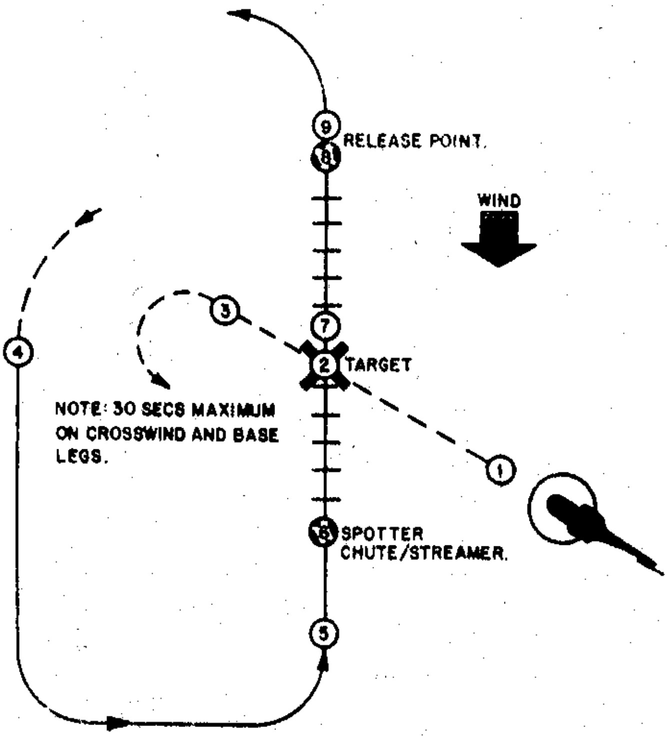
(g) Special considerations. To inform the pilot of the location of the spotter chute, streamer, or jumper, use clock positions relative to the last final flown; i.e., the spotter chute landed at the 12 o'clock position, 100 yards away, etc.

(2) Hand signals: When off intercom, the jumpmaster will use the following hand signals to relay course corrections through the safetyman (they will be briefed prior to flight).

(a) Thumb-left/right indicates five degree corrections.

(b) Straight ahead is indicated by a vertical "slicing" motion parallel to the longitudinal axis of the aircraft, hand held perpendicular to the floor.

(c) Abort jump or lost target is indicated by clinching the fist and placing it in front of the first jumper for an aborted jump, or passing the hand in front of the face to indicate that the DZ is lost.



1. Head directly toward the target, regardless of the wind direction.
2. Release the spotter chute/streamer directly over the target. (If required)
3. Immediately upon release, make left/right turn to observe descent and position of spotter chute/streamer.
4. Establish rectangular drop pattern oriented so that the final approach will be aligned with the spotter chute/streamer and the target, respectively.
5. Turn on approach. Make minor changes in heading to pass over the spotter chute and the target on a direct line. Aircraft drift correction should be established prior to passing over the spotter chute.
6. Initiate uniform count over the spotter chute/streamer.
7. Reverse count over the target.
8. Deploy the second spotter chute/streamer (if required) or parachutist when the last digit in reverse count is reached.
9. After the jumper clears the aircraft, turn to observe the accuracy of the drop.

Figure 21-5. Non Tactical Spotting and Personnel Parachute Delivery—Fixed Target.

21-13. Personnel Parachute Delivery Emergency Procedures. Parachutist towed behind aircraft:

a. Altitude Requirements. If a parachutist becomes fouled in clearing the aircraft and is being towed behind, the pilot will maintain an altitude of at least 1500 feet AGL. Avoid flying over built up areas or water; except scuba equipped parachutists will be flown over water.

b. Parachutist Procedures. The parachutist will indicate that he is conscious and that the reserve chute is ready for use by placing one or both hands on the top of his helmet.

c. Aircrew Procedures:

(1) If the parachutist is conscious and his reserve chute is ready for operation, the static line will be cut. The decision to cut the parachutist free will be made by the aircraft commander.

(2) If the parachutist is unconscious or the reserve chute is not ready for operation, the aircraft will come to a high hover and the parachutist will be lowered vertically to the ground. The recovery method will be as directed by the aircraft commander if the aircraft cannot make an immediate landing.

21-14. Free-Fall Swimmer Delivery Operations. This maneuver provides an effective method of delivering a swimmer(s) near a target or objective area in the water. Free-fall swimmer delivery may be utilized by all 23 AF forces. These procedures apply to daylight, and RSOLL/SOF NVG and HH-53H unique operations.

a. Determine the wind direction prior to personnel delivery. Some objectives can drift up to 10 percent of the wind velocity. Usually, personnel deliveries should be made downdrift of the objective. When mission circumstances warrant deliver swimmers upwind or offwind.

b. Make an approach into the wind at a maximum of 10 ft AWL and 10 knots daylight, or 15 ft AWL and 15 knots at night.

c. Deployment Procedures:

(1) Safetyman positioning/exit points:

(a) H-3/H-53 forward door edge/personnel door or aft ramp, as applicable.

(b) H-1/H-60 forward and slightly aft of the last deploying team member/sitting position from either or both cabin doors.

(2) Safety considerations during final approach:

(a) The team members should be in a position to view the objective area at approximately 50 ft AWL.

(b) All exits will be open at 50 ft AWL and below. Deploying personnel will be in a restraining harness or safety belt prior to and on the descent into the 10 knots and 10 ft AWL flight regime.

(c) The "Thumbs-up" from the safetyman to the deploying team on final indicates 10 ft AWL and 10 KTS is confirmed and the team is cleared to deploy at the team leader's discretion. **WARNING:** The safetyman will insure the departing team members have removed their restraining device(s) prior to deploying.

(d) All required water hoist extraction devices should be on board, inspected, and rigged prior to low and slow deployments.

(e) It is recommended that all rescue hoist checklists be completed in the event an injury occurs to the departing team. An immediate extraction may be required. The rescue hoist hook (H-3/H-53) will be stowed, so the cable is not in the doorway.

(f) The team leader will brief equipment delivery procedures (i.e., the safetyman or another team member may be required to deploy the Stokes Litter).

(g) The safetyman will insure adequate gear/airframe clearance exists during deployments.

(h) Deploying team members should show a "Thumbs-up" signal after water entry. This indicates they are "OK" and have not sustained injuries.

d. If a pattern is planned, aircrews will use the typical water hoist patterns depicted in chapter 16. Regardless of the type pattern flown, turns will not be accomplished below 50 feet AWL. If OGE power is not available, a minimum of 50 KIAS will be maintained during the water recovery pattern.

e. Restrictions:

(1) Day:

(a) When conducting free-fall swimmer deliveries a safety boat should be present at the water training site.

(2) Night: (May only be accomplished by RSOLL/SOF)

(a) When conducting free-fall swimmer delivery at night for USAF personnel, a safety boat or second hoist equipped helicopter will be present. When delivering other than USAF personnel a safety boat or second hoist equipped helicopter should be present.

(b) Only aircraft with an operable radar altimeter will be used.

(c) A flare ship is required for SOF aircraft other than PAVE LOW aircraft.

(d) The hover coupler should be used to reduce the possibility of overcontrolling.

21-15. Swimmer Recovery Procedures. The most expedient recovery procedure is by hoist. Hoist recovery procedures in chapter 16 apply for all water hoist recoveries. An alternative method of recovery is by rope ladder. Procedures listed in chapter 27 concerning rope ladder operations always apply to water operations. Insure the rope ladder is grounded in the water prior to reaching the first swimmer.

21-16. Helo Cast/Boat Delivery Operations. The following procedures will be used for delivering zodiac boats.

a. Zodiac Configuration:

(1) Remove keel guard if desired. The boat may be laced to plywood or suitable material which will roll easily on the aircraft roller system.

(2) The boat will be loaded bow or stern first, two boats may be loaded if loaded bow first. The boats should be secured with at least two cargo tie-down straps per boat and should have a short bow/stern line to hold the boat when the straps are removed just prior to drop.

b. The following procedures will be briefed and used.

(1) At "5 minute" call, team members who will deploy from the front, if this method will be used, will move to the front of the cabin area. The team members who will deliver the boat will prepare for exit in the aft.

(2) At "1 minute" call the team members and crewmembers will prepare the boat for drop by removing tie-down straps except bow/stern line.

c. The pilot will approach a 10 ft wheel height above the waves while slowing to 10 to 15 knots groundspeed. The hover coupler may be used. The pilot not flying/flight engineer will call out radar altimeter readings to the pilot.

d. The pilot will acknowledge "clear to drop." When cleared, the designated crewmember/team member pushes the boat out.

NOTE: Pilot will clear team to exit after the boat has left. The team may exit the aircraft from either the door or ramp or both. If both are used the ramp delivery will be executed first.

e. The delivery team leader will remain on intercom until the 1 minute call. A prebriefed crewmember on intercom will be designated to relay the clear to drop signal to the team. Concise briefings and good crew coordination are a must in conducting safe helo cast operations.

SECTION B—EQUIPMENT DELIVERY OPERATIONS

21-17. General. There is seldom a tactical requirement for airdropping equipment from helicopters. The procedures in this chapter are provided for those instances where equipment airdrops are required due to terrain or enemy activity. Airdrop operations refer to air movement of supplies or equipment in which unloading of equipment is accomplished in forward flight. Only free-fall bundle drops are recommended.

21-18. Wind Limitations for Equipment Airdrops:

a. Surface wind: 17 knots

b. Drop altitude winds: 40 knots

21-19. Procedures. Briefings, drop zone markings, authentication, and abort procedures are identical to those procedures listed in Section A—Personnel Delivery. The approach should be planned so that delivery of equipment can be accomplished at the lowest airspeed and altitude that will allow safe flight. Caution must be exercised to preclude injury to personnel on the ground during the delivery. Drops will always be made to targets set up by ground personnel. Aerial delivery of equipment will be accomplished in the following manner:

a. Ground forces personnel are responsible for selecting the DZ and marking the desired point of impact with panels, smoke, or lights. The pilot is responsible for selecting the release point and initiating the airdrop so that the cargo impacts as closely as possible to the designated impact point (target).

b. Free drops should be made at as low an altitude as safety permits but never above 200 feet AGL.

c. Refer to figures 21-5 and 21-6 for additional guidance concerning free-fall ballistics and DZ markings.

FREE DROP BALLISTICS DATA CHART

Ground Speed (knots)	120	110	100	90	80	70
Vertical Distance (feet)	Horizontal Distance (Yards)					
200	228	210	191	173	155	137
180	217	199	182	164	146	128
160	205	189	172	155	138	121
140	193	177	161	147	131	115
120	179	164	150	135	120	105
100	163	150	137	123	109	95
80	147	135	123	111	99	87
60	128	117	107	96	87	77
40	105	96	88	79	70	61
20	74	68	62	56	50	44

Figure 21-6.

21-20. Seven/20-Member Life Raft Delivery:

a. Preparing the raft for drop:

(1) Open the raft case at both ends, and attach two strobe lights with parachute cord to either the canopy pole mounts located around the outside of the raft, between the inflation chambers, or the hand hold tape which is located around the floor to the raft. Turn the lights on and shut the raft cover prior to drop.

(2) Remove the raft inflation D-ring from its pocket, and leave the pocket unsnapped.

(3) Securely tie a 14-inch piece of MIL-T-5661-C web tape through the D-ring to form an approximate 5-inch loop.

(4) Attach a 10-foot lanyard (the one used for flare drops) to the tie-down ring located by the forwardmost part of the side cargo door. Attach the other end to the 5-inch loop of web tape.

(5) Snap the carrying handles together beneath the raft.

b. Delivery Procedures:

(1) Use a smoke device on all life raft drops to assist in determining the exact wind direction and a drop reference.

(2) Use normal traffic pattern airspeeds/altitudes.

(3) Make a shallow approach in order to establish level flight at 40 knots and 75 feet altitude on final. Two crewmembers work together, one to monitor the survivor and to signal the other crewmember to deploy the raft when directly over the survivor. Delay the drop one second for every 5 knots of wind over 10 knots. After dropping the raft, call "raft away" and immediately recover the lanyard.

c. Safety Procedures:

(1) When scanning or conducting life raft deployments, all personnel will wear the safety harnesses to preclude accidental exit from the helicopter.

(2) Use the radar altimeter if installed and operable.

(3) It may be necessary for two men to work together to deploy the 20-member raft.

(4) A V-blade knife should be available to cut the raft if it should become entangled.

(5) Do not hold the 10-foot lanyard after the raft is dropped.

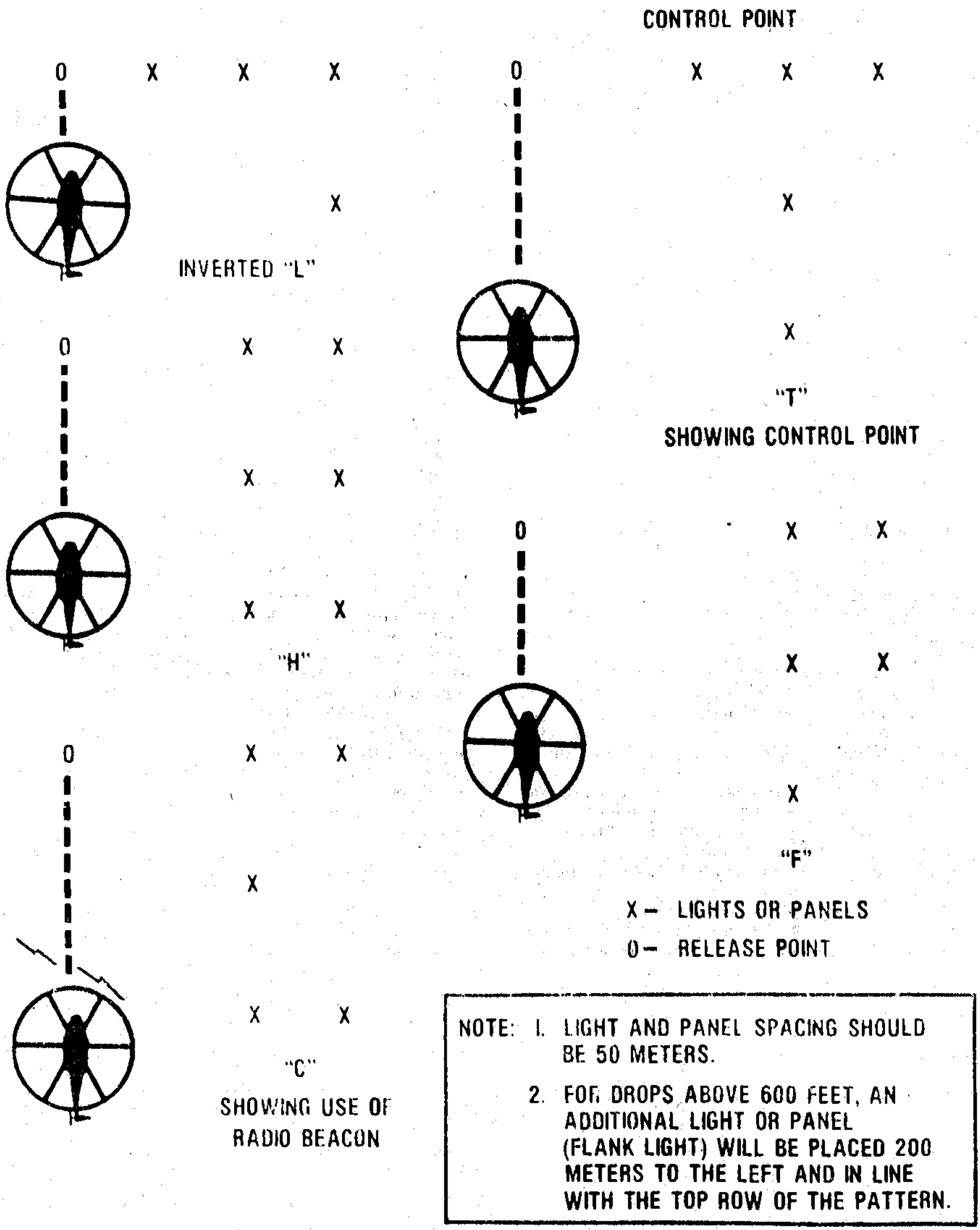


Figure 21-7. DZ Markings.