Chapter 15

MEDICAL EVACUATION/MAST

15-1. Aeromedical Evacuation Missions. (Not applicable to MAST missions.) Aircraft will not be used for routine patient transfer. Medical evacuation flights may be operated to transport seriously ill or injured persons and/or to transport medical personnel, equipment or supplies under emergency conditions when other means are not suitable or readily available. Prior to dispatching an aeromedical evacuation mission, obtain the best medical evaluation available to determine the need for rescue assistance. This evaluation is not the final determinant that the mission will be performed.

15-2. Medical Assistance. SAR missions involving life threatening injuries/illnesses require immediate launch because any delays in reaching the patient/survivor further decrease the probability of survival. Avoid delays whenever and wherever possible. If one or more qualified pararescuemen are immediately available, deployment of aircraft/helicopters will, as a rule, not be delayed pending arrival of a local flight surgeon/physician. When feasible, the flight surgeon/physician may be transported by another aircraft/helicopter. The flight surgeons/physicians will assist in emergencies and when used, are in charge of the medical aspects of the mission. They provide specialized medical skill and equipment beyond the capability of 23 AF pararescuemen. Unit commanders should continuously coordinate their local mission response criteria and requirements with flight surgeons/physicians so potential delays can be avoided. To familiarize the flight surgeons/physicians with procedures and available medical equipment, encourage their participation in training and operational missions, whenever possible.

15-3. MAST Missions. Certain 23 AF helicopter units are designated as Military Assistance to Safety and Traffic (MAST) units. These units are tasked to provide assistance in serious civilian medical emergencies (i.e., situations when an individual's condition requires airevacuation to a medical care center as soon as possible to prevent death or aggravation of illness or injury). The decision to request a MAST helicopter is based solely on the judgment of the law enforcement officer, physician, or other responsible persons at the scene of the emergency. Assistance may be provided if it does not interfere with the military mission. The authority for the MAST program is contained in the Defense Appropriation Act, Public Law 93-155. Refer to AFR 64-1 for specific guidance.

15-4. Hazardous Medical Equipment Aboard Rescue Aircraft:

a. Any nonstandard medical equipment used during air evacuations should be regarded as potentially hazardous. Nonstandard electronic and oxygen equipment is an item designated by manufacturer and model number that is not listed in the current "Status Report on Medical Material Items Tested and Evaluated for use in the Aeromedical Evacuation System," Brooks AFB, TX 78235. Authorization for medical material not listed in this report will be addressed to ARRS/SG on an individual basis. If approval is granted for the use of nonstandard medical equipment, two types of equipment are of major concern:

(1) Electronic medical equipment that produces electromagnetic interference (EMI) which can interfere with aircraft communication and navigational equipment.

(2) Therapeutic oxygen systems present an increased hazard of fire/explosion.

b. Take the following precautions for nonstandard electronic medical equipment:

(1) Pararescuemen (or attached medical technician) must inform the A/C when nonstandard electronic medical equipment is brought aboard the aircraft. Include the anticipated period of use of the equipment during the mission.

(2) Be alert for any interference with aircraft communication or navigation equipment caused by this equipment.

(3) When continuous use of the equipment is required throughout the duration of the mission, flight is restricted to VFR conditions. Use additional caution on night VFR missions to ensure there are no adverse effects on navigational equipment.

c. Take the following precautions for nonstandard oxygen equipment:

(1) All compressed oxygen equipment with exposed unprotected cylinder neck, manifold or regulator must be completely secured from all movement in its longitudinal and lateral axes.

(2) Pararescue (or attached medical technicians) must continually monitor the operation of the equipment to detect possible malfunction during flight.

Chapter 16

HOIST OPERATIONS

16-1. General. The following procedures apply to both day and night operations. Parachute flares provide the best possible illumination for night hoist operations, but if not available, hoist operations at night can be safely accomplished using aircraft lighting/night vision goggles/pave low system. Use these procedures unless there is a conflict with the flight manual.

16-2. Rescue Devices. The aircrew determines which device to use. A survivor unfamiliar with the rescue device should be assisted by a crewmember, briefed over a loud hailer, or provided printed instructions attached to the device to ensure proper entry and security for a safe pickup. The rescue hoist will not be used to relay messages except when all other possible means of communications (i.e., radio, message streamers, loud hailer) have been exhausted. In this event, the rescue hoist may be used only when necessary in a life or death situation, or to determine if one exists.

NOTE: Rescue devices used for hoist training will be identical to and configured the same as operational equipment. If live hoist training is to be conducted, only operational equipment will be used.

a. Forest Penetrator:

(1) The description and maintenance instructions for the forest penetrator are contained in TO 14S6-3-1 and TO 00-25-245, section IV.

(2) The forest penetrator can be used for single or multiple recoveries from land or water. It is recommended for recovering personnel whose parachutes have become entangled in trees. It allows assisting personnel use of both hands to aid the survivor. The forest penetrator can be used to recover inert or injured personnel safely with the exception of those with back injuries.

(3) Procedures:

(a) Establish a stable hover. Fold the seat paddles and stow safety straps with the zippers closed before lowering the forest penetrator through trees or dense foliage.

(b) If the hoist operator loses sight of the rescue device, the cable tension must be relied upon to detect when the penetrator has reached the ground. If it appears that the penetrator has reached the ground, it should be raised several feet and relowered to ensure that it is not hung up.

(c) When there is no visual or oral communication with the survivor, the hoist operator will hold the hoist cable, for survivor's signal. Jerks on the cable is the signal to start retrieving the cable. Hoist retrievals from trees must be slow enough to allow survivors to fend off branches, and prevent cable entanglement.

(d) It may be possible for a crewmember on the penetrator to recover the survivor without unstrapping from the penetrator.

(e) It is possible to recover three people at one time with the penetrator. However, this should only be done when time is critical since it may load the hoist to the limit.

(f) If the crewmember leaves the penetrator to assist the survivor during a tree recovery, fold the seat paddles and stow the safety straps with zippers closed so that they will not snag on obstructions if the helicopter moves or the hoist cable has to be retracted.

(g) For water recoveries, install the flotation collar prior to lowering the penetrator. Place at least one seat paddle in the down position and remove one safety strap from the stowed position. Do not unhook the safety strap fastener from the penetrator.

b. Stokes Litter:

(1) Description. The device is constructed of wire mesh and light weight steel tubing that holds a survivor immobile in a supine position. The sides of the litter protect the survivor from bumping against obstructions or the side of the helicopter during retrieval. The stokes litter will be configured with the sling, flotation devices, and three restraining belts when stowed on the aircraft. Construction, modification, inspection, and maintenance instructions for the stokes litter are contained in TO 00-75-5.

(2) Applicability. The stokes litter should be used to immobilize the survivor. Once the survivor is strapped securely in this device, he/she need not be moved until arrival at the medical facility. The stokes litter will be secured to helicopter prior to takeoff.

(3) Procedures

(a) To lower the litter, place it outside the aircraft foot end first; then move it parallel to the side of the helicopter. The hoist operator may be required to lean out of the door to maneuver the litter.

NOTE: For water recoveries, the stokes litter may be deployed utilizing the low and slow deployment procedures (see chapter 21). This is the quickest means of deployment and subjects a critically injured survivor in the water to less exposure to rotor wash.

(b) Lower the stokes litter to the survivor after the helicopter is established in a hover. The hoist operator provides enough slack so that the crewmember can disconnect the hoist cable. It is not necessary to stay over the survivor once the litter is removed. After the survivor is secured in the litter and ready for hoisting, the crewmember reconnects the hoist cable and ensures that rescue hook safety pin and carabiner locking sleeves are properly positioned. When using the stokes litter, ensure that the survivor is securely strapped in the litter prior to hoisting. For small patients, the belt can be routed directly across the patient. For large patients, the belt can be routed outside and over the top bar before securing patient to the litter.

(c) Use extreme care when hoisting the Stokes litter because of litter pendulum action and rotation. These actions may increase to unmanageable proportions if they are not quickly stopped by the hoist operator. The pendulum action is dampened by moving the cable in the opposite direction of the litter movement. Litter rotation can be stopped by rotating the hoist cable in a one- to two-foot diameter circle in the opposite direction of the rotation of the litter. In extreme emergencies if litter rotation cannot be stopped by the hoist operator, the pilot can transition to forward flight at an airspeed of up to 40 knots (30 KIAS H-1's) to stop oscillation and rotation.

(d) Stop the litter just below the helicopter. Then maneuver the litter to align it parallel to the aircraft. At the same time, push the litter outward so that the basket does not contact the side of the helicopter. Litter maneuvers may require both hands. This maneuvering may be accomplished by using the litter cables.

(e) When the stokes litter is parallel, raise the litter to the full-up position so that the litter is above the cabin floor level. Turn the litter perpendicular to the aircraft and pull it into the cabin head first. The pilot or another crewmember may have to provide cable slack at this point.

c. Rescue Net:

(1) Description: The Rescue Net (NSN 1670-433-3426LX) is constructed of stainless steel tube frame and 5/16 inch polypropolene netting. The net weighs approximately 20 pounds. A sea anchor drogue is provided to position and stabilize the net and allow for flight path corrections. The sea anchor drogue may be replaced by a 10-foot line with a three-five pound bag of shot for stability.

(2) Applicability. The rescue net is particularly useful for recovery of personnel not familiar with the forest penetrator and/or stokes litter. Because entry is easier and more rapid for a survivor than a forest penetrator. It is perhaps the best device for recovery of survivors from frigid waters.

(3) Procedures:

(a) The rescue net may be lowered on final approach at airspeeds below 30 knots. While in forward flight for a water recovery, the 10-foot line may be allowed to contact the water prior to reaching the survivor. Lower the net to the water short of the survivor at an approximate ground speed of three-five knots.

(b) Raise the net as soon as the survivor enters it. Do not wait for a signal from the survivor. As soon as the net clears the surface, the survivor is forced to its back and prevented from falling out.

(c) An immobile survivor may be recovered in the same manner except that a crewmember may have to ride down in the net to assist. A stable hover is required for this type pickup.

(d) Due to the size of the net, remove the survivor from the net prior to bringing the net into the helicopter.

CAUTION: The rescue net must be held firmly against the helicopter while the survivor or crewmember depart the net.

16-3. Hoist Operator. The primary hoist operator will be the flight engineer; however, any crewmember may be designated the rescue hoist operator as the mission dictates. Therefore, all crewmembers should understand these duties. The hoist operator's duties are to relay directional instructions on interphone and to operate the hoist from the cabin position leaving the pilot free to concentrate on hovering. When radio contact is not available, hand signals will be used between ground personnel and the recovery helicopter.

a. Ground the hoist to discharge static electricity to prevent personnel on the ground or water from sustaining a shock. To preclude ignition of fuel, do not ground the hoist near spilled fuel from damaged aircraft or vehicles.

b. Use caution during hoist operations; ensure that slack cable is held to the minimum necessary to perform the recovery. Excessive slack can be especially dangerous during water recovery where the survivor cannot see the cable.

c. Notify the aircraft commander any time the hoist cable cannot be adequately monitored. In such cases, alternate methods of making the pickup should be considered or an additional crewmember should be used to help monitor the hoist cable.

d. Greater than normal oscillations may occur when the hoist cable is raised and lowered without some weight attached.

e. If pendulum action and rotation of the rescue device are not quickly stopped, the rotations may increase to unmanageable proportions. The pendulum action may be dampened by moving the cable in the opposite direction of the movement of the rescue device. Rotation of the rescue device can be stopped, if detected early, by rotating the hoist cable in a one-or two-foot diameter circle in the opposite direction of rotation of the rescue device.

f. Do not conduct hoist training with the hoist operator's interphone inoperative.

16-4. Power Available Check. See paragraph 6-77, this regulation.

16-5. Land Hoist Procedures:

a. Smoke Drop Pattern. Determination of wind direction and velocity is important to successful hoist operations. If a smoke device is used, plan an approach to drop the smoke device as low and slow as terrain permits. Complete the smoke drop checklist and deploy the smoke device near the survivor. Deploy smoke close enough to the survivor to give accurate wind information and, if possible, in an area that can be seen from anywhere in the hoist pattern. Select a nonflammable target area for the smoke device.

b. Hoist Pattern:

(1) Complete the pilot's alternate insertion/extraction checklist and the hoist operator's checklist prior to starting final approach for hoist recovery.

(2) If possible, establish a right-hand, rectangular pattern with a final approach oriented into the wind. This aids in keeping the survivor in sight while preparing for the pickup.

(3) Keep the hoist operator informed of position in the pattern at all times. Likewise, the hoist operator informs the pilot when ready to deploy smoke markers or accomplish the pickup.

(4) During descent at night or adverse conditions, the copilot will call out altitudes in 100-foot increments when above 300 feet AGL and 50-foot increments when below 300 feet AGL. (Exception: During MH-53 operations)

(5) If the survivor appears to be injured and attached to the parachute, hover at an adequate distance to prevent the rotor wash from billowing the parachute and dragging the survivor.

c. When the pilot has determined that the recovery can safely be accomplished, direct the hoist operator to "Go Hot Mike" prior to losing sight of the survivor. Devote full attention to maintaining a steady hover, use all available references and the hoist operator's instructions. The copilot will monitor the engine instruments, help maintain adequate blade tip clearance and remain oriented with the horizon throughout the hoisting operation to assist the pilot should the need arise. The hoist operator will assist the pilot in maintaining adequate rotor tip clearance to the rear and right side of the helicopter. The rear ramp of the H-3/H-53 may be opened to aid in clearing the rear of the helicopter.

d. When the survivor is in the rescue device and ready for hoisting, the hoist operator will give instructions to position the helicopter over the survivor and take up any slack in the cable. Normally, the hoist operator will raise the survivor, however he may request the pilot to "raise helicopter." The hoist operator will keep the pilot advised of the survivor's position. When the survivor is in the cabin, notify the pilot and complete the after pickup checklist. When over trees, advise the pilot when the survivor is clear of the trees.

e. For H-53 hover coupler operations, the flight engineer (FE) may be directed to take control of the aircraft and operate the hover trim control. The hover trim control stick is immediately engaged upon notification from the pilot. The FE will hover taxi the helicopter, using the Hover Trim Control, to a position over the area. Once positioned over the area, the FE may transfer control to the pilot for the appropriate operation.

16-6. Land Hoist Precautionary Measures:

a. Hoist operators will monitor interphone.

b. Hoist training over trees may be conducted at authorized sites that are adjacent to a suitable emergency landing area. During exercise training, comply with exercise procedures in chapter 9, tab B.

16-7. Deployment Water/Hoist Procedures. Water hoist recoveries may be accomplished day or night. Lack of depth perception and possible disorientation at night and in marginal weather require more precise smoke drop patterns and procedures. Use day procedures during both peacetime and combat exercise operations. H-53 water hoist operation will normally be accomplished with the landing gear down. H-3/53 may be flown over water with the gear pinned down.

NOTE: Pulling the landing gear warning system circuit breaker on the H-53 is not authorized.

The hover position for water hoist is directly over the survivor. However, once the rescue device is lowered to the water, the pilot may elect to back to a holding hover. Once the survivor is ready for hoisting, the pilot should establish the hover over the rescue device prior to hoisting the survivor out of the water.

CAUTION: Smooth water adversely effects depth perception.

a. Day Pattern:

(1) Complete pilot's alternate insertion/extraction checklist and hoist operator's checklist prior to final approach.

(2) After initial sighting of the survivor, maneuver to a position approximately 100 feet downwind of the survivor from which an observation pass can be accomplished (figures 16-1 and 16-2). If the survivor's condition is unknown or swimmer deployment is anticipated, the observation pass will be made at a maximum of 10-feet AWL and 10 knots between zero and 90 to the wind line to allow for swimmer deployment. If swimmer deployment is not required, make the observation pass above translational lift airspeed at approximately 25-feet AWL.

(3) After the observation pass, initiate a climbing right turn at 50 feet AWL to a 100 feet AWL minimum downwind altitude. Deploy sea dye or smoke markers as directed by the pilot. If OGE power is not available, a minimum of 50 KIAS and 50 feet AWL is required prior to initiating the climbing turn to downwind. With OGE power, start the turn at a minimum of translation lift airspeed and 50 feet AWL. Use sea dye instead of smoke markers to avoid detection during combat or when an oil or fuel spill is near the survivor. In high sea states or high winds, use of more than one sea dye is recommended. During combat water training at locations that prohibit use of sea dye marker, aircrews may use a smoke marker as a hover reference. If use of sea dye or smoke markers is prohibited or not required proceed without them.

(4) Roll out on downwind and then continue turn to final. Do not descend below 50 feet AWL until established on final. If the survivor is not ready for immediate pickup, tactical situation permitting, establish a holding hover approximately 75 feet downwind of the survivor.

(5) On final, descend to hover altitude and slow to approximately five knots forward hover speed 75 feet downwind from the survivor. If the helicopter instrument panel interferes with forward visibility, the final approach may be displaced to the left.

b. Night or Marginal Weather Water Hoist Pattern: (NA to Pavelow or NVG operations)

(1)Upon initial sighting of the survivor, deploy a smoke marker in the immediate vicinity of the survivor:

(2) After the wind direction is determined, establish a smoke drop pattern at 300 feet and 70 KIAS (H-1, H-3), 80 KIAS (H-60A), and 90 KIAS (H-53) so that the final approach pass over the survivor is aligned approximately 30 degrees to the right of the wind direction.

(3) Commence pilot's insertion/extraction checklist and hoist operator's checklist prior to initiating final for the pickup.

(4) When immediately over the survivor, the hoist operator will deploy all three markers with one second intervals—the first two markers should be dropped stratight downward while the third should be thrust outward and downward at an approximate 45-degree angle from the heading of the aircraft. The pilot may delay the deployment of the smoke markers for up to three seconds after passing ovar the survivor when conditions warrant extended hover, i.e., exceptionally high hover heights, or strong wind/current conditions. Sea dye may be used in addition to or in lieu of smoke markers (i.e., the sea dye marker is a safer method of establishing a hover reference when an oil/fual spill is near the survivor). If sea dye is used in addition to smoke markers, deploy it prior to the smoke markers.

(5) Normally, a right hand rectangular hoist pattern is flown with a final approach to the wind, see figure 16-3. When parachute flares are deployed, a left hand pattern is flown to avoid descending flares. Remain conscious of the location of descending flares, duds and burned out flares. Unnecessarily extending the hoist pattern may result in losing the survivor's position.

(6) The pilot will keep the hoist operator informed of the position of the aircraft in the pattern at all times. The hoist operator will acknowledge each position report and keep the pilot abreast of all changes.

(7) Establish final approach using the survivor and smoke markers as references. Once the approach is started, cross-reference the flight instruments so as to reach approximately 200 feet AWL with an approximate forward speed of 30 knots (unless using HH-53H unique systems and TF altitude is lower). Decrease airspeed and altitude to reach a minimum hover as determined by sea state, salt spray, and power reserve. During the last 100 feet of the approach, the rate of descent will be a maximum of 300

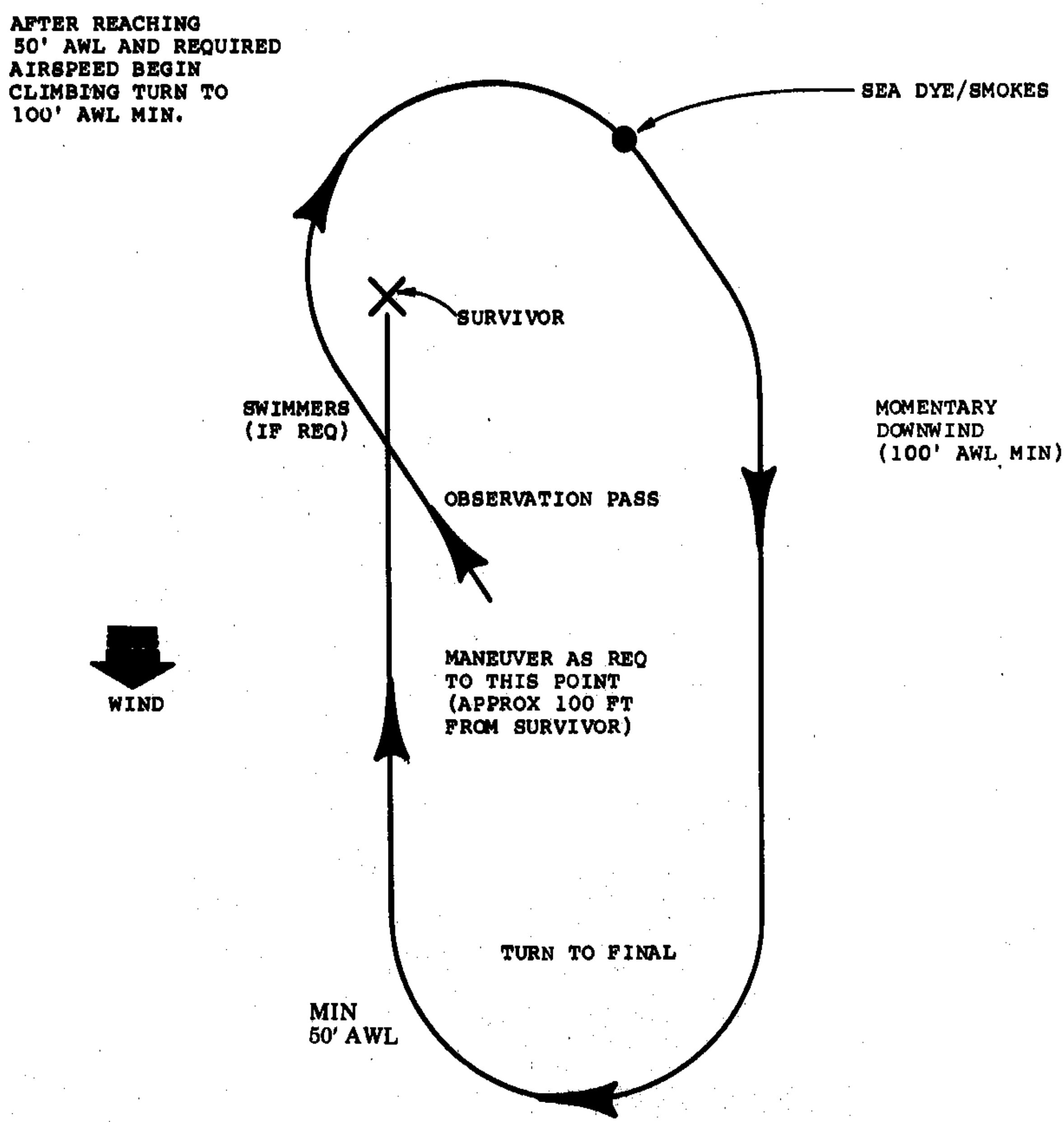


Figure 16-1. Typical Water Hoist Pattern—H-3/H-53/H-60A.

1. Deploy swimmers 10-30 yds downwind from survivor.
2. Deploy sea dye 10-30 yds from survivor.
3. Do not deploy sea dye directly upwind from survivor.
4. Maintain 50 KIAS minimum during climbing turn and downwind if OGE power is not available.

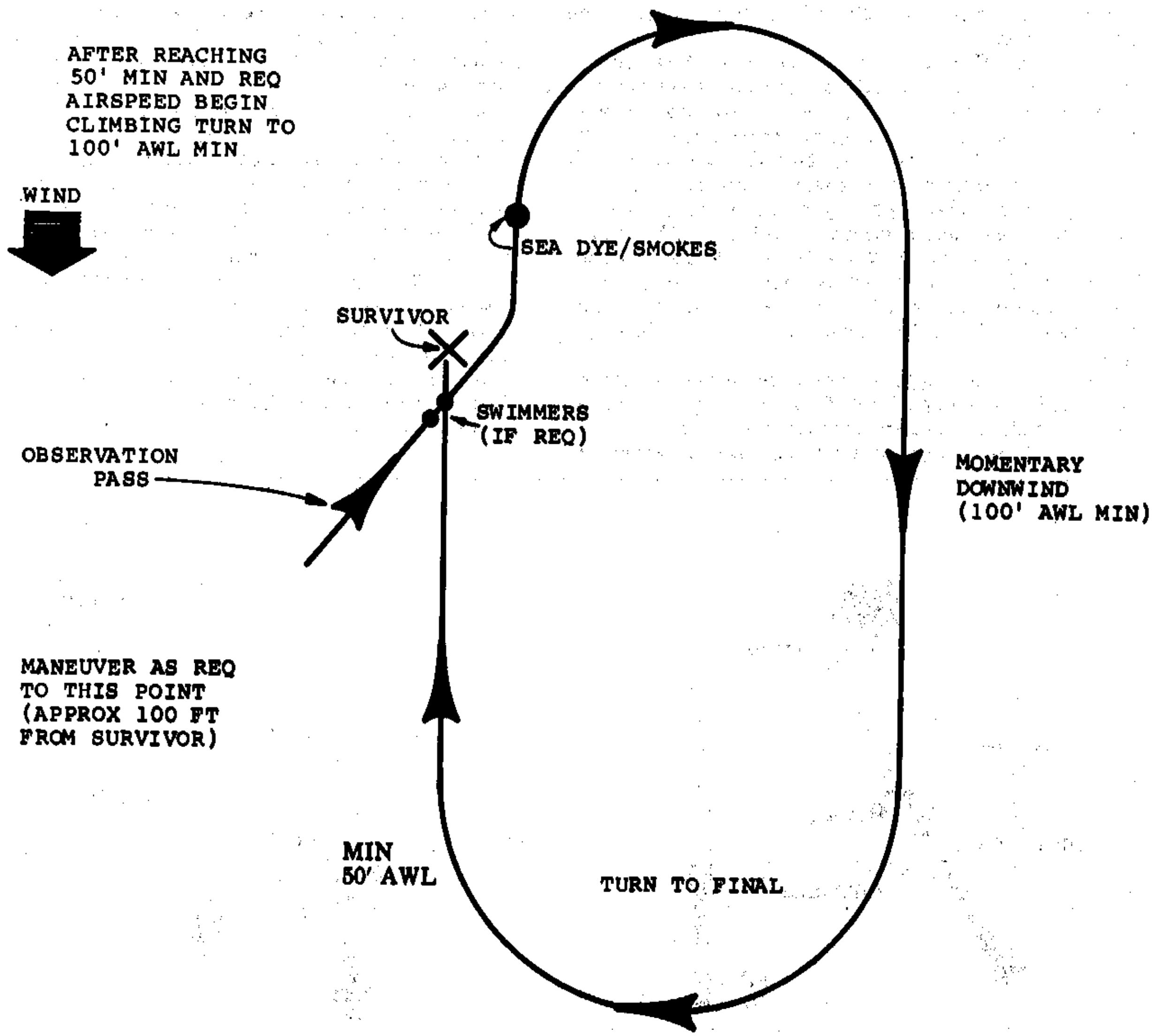


Figure 16-2. Typical Water Hoist Pattern—H-1/60A.

1. Deploy swimmers 10-30 yds downwind from survivor.
2. Deploy sea dye 10-30 yds from survivor.
3. Do not deploy sea dye directly upwind from survivor.
4. Maintain 50 KIAS minimum during climbing turn and downwind if OGE is not available.

FPM. The hover altitude should be established approximately 75 feet short and downwind from the survivor while allowing the helicopter to continue moving slowly forward to the hover point. If the helicopter instrument panel interferes with forward visibility, the initial hover may be offset to the left.

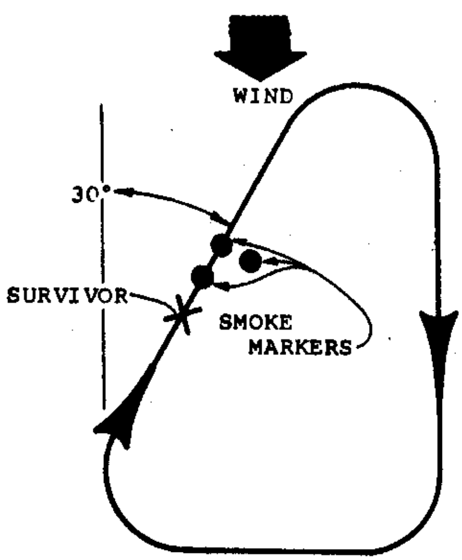
(a) Normally, use all available lighting. Lighting configuration may be varied in conditions of restricted visibility. Large and excessive movements when adjusting the search or landing light may induce vertigo.

(b) Cross reference the radar altimeter with the barometric altimeter throughout the pattern and hover. The pilot not flying/flight engineer calls out passing altitudes in 100 foot increments above 300-feet AWL and in 50 foot increments below 300 feet AWL. Monitor rate of descent and call out excessive decent rates. A steep and/or fast final approach at night is extremely hazardous. If airspeed and/or rate of descent are excessive on final, go around.

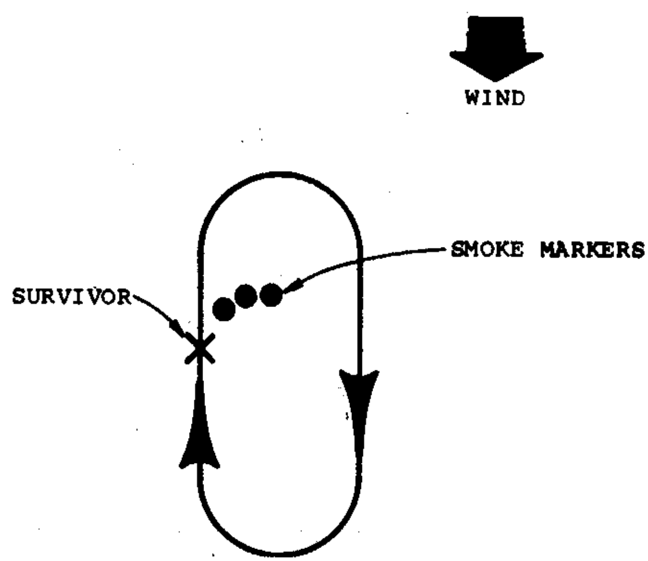
(c) Attempt to determine where the smoke generated by the markers is drifting. Under light or variable wind conditions, the smoke may pose a visibility and orientation hazard. Be prepared to execute a go-around, if necessary.

c. Recovery Phase: Pilots must devote full attention to altitude control and power settings during the transition from the approach to the hover phase. Prior to losing sight of the survivor, direct the hoist operator to "Go Hot Mike." The hoist operator should shift visual references from the water to the horizon at frequent intervals to prevent spatial disorientation. When the survivor is in the rescue device and ready, the hoist operator gives instructions to position the helicopter over the survivor, takes up any slack in the cable. Normally, the hoist operator will raise the survivor, however, he may request the pilot to "raise helicopter'. The hoist operator will keep the pilot informed of the survivor's position. When the survivor is in the cabin, complete the after pickup checklist.

(1) A raft approached very slowly will be blown along slowly in advance of the rotor wash. As a raft is approached, do not excessively slow the closing speed, but move smoothly toward and directly over the raft. Hovering over small boats may present the same drift difficulties as a raft. Personnel supported by life jackets present no drift problem.



WATER SMOKE MARKER PATTERN



WATER HOIST PATTERN

(Note: Entire pattern may be flown race-track 30° off-set from wind)

Figure 16-3. Night/Marginal Weather Water Hoist Pattern.

(2) If the survivor appears to be injured and is attached to the parachute, hover at an adequate distance to prevent the rotor wash from billowing the parachute and dragging the injured survivor.

(3) The pilot must not attempt to watch the pickup as spatial disorientation may result. Pilot vertigo can become a problem during night hoist recovery. Use the attitude indicator as an additional reference in conjunction with the dye and smoke markers.

(4) Beware of the tendency to drift backwards while hovering at night over water. This may result in a loss of relative wind and loss of lift causing the helicopter to descend. If allowed to continue, sufficient power may not be available or overtorque of the main gear box may be required to recover.

16-8. Water Hoist Precautionary Measures. Conduct water training at approved water operating areas:

a. Surveillance by a motorpowered surface vessel or hoist equipped helicopter is required for single- engine helicopters during water training. The surveillance helicopter will be prepared to deploy a 7- or 20-member life raft.

b. Do not conduct water hoist training/evaluation in single-engine helicopters over water when water temperature is below 55° F.

c. Conduct all water hoist training a minimum of 100 yards offshore.

d. Night water hoist training requires:

(1) Ceiling and Visibility. When parachute flares are used, 500 feet above flare drop altitude and three miles.

(2) A rescue configured HC-130 capable of deploying PJs or MA-1 kits in absence of a surface vessel or another hoist equipped helicopter. EXCEPTION: A non-hoist capable H-3 may be used provided the sea state is three or less. The H-3 must carry a fully qualified rescue crew.

(3) Operable radar altimeters when installed.

(4) Each helicopter will either drop smoke or fly a simulated smoke drop pattern at prescribed altitude if using another helicopter's smoke. (N/A MH-53 when operating on unique systems.)

(5) Parachute flares are not required for training in sheltered areas (inland lakes, bays, etc.) where sea state conditions are not a safety factor. Open sea NWH training requires parachute flares except MH-53, when operating on unique systems. IPs may direct a pattern and recovery without flares to familiarize the crew with limited visibility operations and precautions. Use pattern in Fig 16-3 when parachute flares are not required.

16-9. Inert Survivor Recovery. Hoisting procedures for the recovery of an unconscious or inert survivor from water or land areas are as follows:

a. The hoist operator determines if the victim is unconscious or unable to enter the rescue device. The pilot directs one of the crewmembers to be lowered by the hoist and another to act as hoist operator. The pararescue specialist, when available, is the primary crewmember for deployment to aid an injured or inert survivor.

b. The hoist operator ensures that the crewmember being lowered is properly equipped and the the equipment is properly adjusted. Advise the pilot when the crewmember is ready to be lowered.

c. Enter the rescue device after the approach. Secure the survivor for hoisting and give a "thumb up" signal to indicate that the survivor is ready for pickup.

16-10. Voice Procedures:

a. The hoist operator directs the pilot over the survivor or hover point using standard terminology. Instructions should be clear and concise with commentary on the progress of the approach and hover operation. The hoist operator can aid the pilot with airspeed control during the approach by describing the reduction of distance, in a numerical sequence, from a given point from the survivor, to a hover point over the survivor. The frequency of numerical calls that are made should indicate the speed of the helicopter toward the survivor or closure rate. A closure rate is not necessarily given in a preset distance of feet, yards, or meters, but is normally associated with one of them. An example would be "survivor at twelve for one hundred, seventy five, fifty, forty, etc." The faster the call, the more rapid the closure. Five, four, three, two, one, stop." If too fast, and you can't safely slow the helicopter down in time, don't hesitate to call a "go around." Standardized words for directions and motion may be added to better describe actions necessary for safe operation, i.e. "Slow forward, turn right, stop back."

See examples below:

DIRECTION	MOTION
Forward	Fast
Back	Slow
Right	Stop
Left	Hold
Up	Turn
Down	Raise helicopter (for initial lifting of survivor by pilot)

16-11. Safety Procedures:

a. Throughout the entire recovery phase, the pilot not flying/flight engineer monitors the flight instruments and advises the pilot when reaching the altitudes, airspeeds, and rates of descent prescribed. When in a hover, the copilot/FE cross-references the attitude indicator and the reference smoke. If the pilot becomes disoriented, initiate an instrument takeoff or direct the other pilot to assume control of the aircraft.

b. Monitor the hoist mechanism to ensure proper cable feedout and retrieval. Crew briefings prior to hoisting will include positive actions to be taken in the event of equipment malfunctions or impending failures such as overheating, oil seepage, unusual cable vibrations, etc. During training missions, terminate live hoisting immediately at the first indication of equipment malfunction. If possible, return the individual to the surface by lowering the aircraft. For actual SAR missions, existing circumstances must dictate actions to be taken. The hoist operator will advise the pilot, check hoist power sources and hoist controls, and request another crewmember to operate the hoist, if necessary.

c. Exercise the utmost caution during hovering operations to preclude anchoring the helicopter hoist hook or cable around an immovable object. The hook and cable should be kept in view at all times to prevent the cable from becoming entangled with ground objects. If the hook or cable should become fouled, attempt to free it by paying out slack and manipulating the hoist. Use caution when applying tension to the cable. If the cable should break, cable whiplash action can cause rotor damage.

d. The hoist operator will wear a heavy, work-type glove on the hand used to guide the hoist cable and have the helmet visor down (visor down is not required when wearing NVG's).

e. When pulling the survivor into the helicopter, the easiest method is to turn the survivor's back to the helicopter and pull in. This procedure reduces the possibility of semiconscious or injured survivor fighting the hoist operator. The rescue device should never be removed from the hoist cable or the survivor until the survivor is safely inside the helicopter and clear of the door.

f. To prevent dropping the rescue device, use the hoist hook safety/retaining pin.

EXCEPTION: When raising or lowering an empty stokes litter for water recoveries, the use of the safety/retaining pin is not required. This makes it easier to remove the litter from the hoist cable. Install the safety/retaining pin prior to hoisting the litter with a survivor.

g. If a loss of power is experienced while hoisting, attempt to lower the person being hoisted to the surface. It may be necessary to cut the cable. Should an inadvertent landing occur, primary consideration must be given to moving away from personnel on the ground.

h. Interphone Failure. If interphone failure occurs between the pilot and hoist operator and cannot be remedied by changing interphone cords, have the copilot or another crewmember relay the hoist operator signals to the pilot. The hoist operator gives directions by moving an open hand with the palm turned in the desired direction of movement. To hold position, clench the fist. The hoist operator can direct use of the hoist control or indicate hoist operation by extending the thumb of a clenched fist either up, down, in or out, as applicable. To indicate "survivor in and secure and ready for takeoff," point in the direction of intended takeoff.

16-12. Purpose of the Tag Line. The tag line aids the pilot by reducing the time required to hover without a reference and prevents pendulum or spinning motion during hoisting. It may be used to guide the rescue device or survivor to or from confined areas such as ship rigging, trees, rotor wash, etc.

16-13. Procedures for a Tag Line Hoist:

a. A weight should be attached to the end of the tag line without the weak link. The other end of the tag line may be fastened to either the hoist hook small eye or the rescue device. Snap the tag line to the hoist hook or the hoisting device by the weak link, just before the device goes out the door.

b. Deliver the tag line from a hover while using extreme care to avoid fouling the line in the rotor system.

(1) To deliver the tag line to a small vessel, establish a hover short of the vessel and lower the tag line to the water and then raise it approximately five feet above the water. The hoist operator will then direct the pilot to the vessel.

(2) To deliver the tag line to a large vessel with a restricted pickup area, the tag line should be lowered after the helicopter is in a hover over the vessel.

c. The pilot normally loses sight of the vessel during deployment of a tag line and has to rely entirely on the hoist operator for position information.

d. Once the tag line is on the vessel and the boat crew is tending it, the hoist operator directs the pilot clear of the vessel while paying out slack in the tag line. When the pilot can again see the vessel, the hoist operator begins to lower the hoist.

e. Shipboard personnel use the tag line to guide the rescue device into the desired location.

f. When the rescue device is on the vessel's deck and the survivor is ready for hoisting, the hoist operator gives directions to position the helicopter back over the deck. Retrieving the rescue device vertically may not always be possible. Be aware of this and be prepared to recover the rescue device at an angle. However, whan conditions permit, always recover the rescue device vertically. As soon as the survivor is clear of the deck and all obstructions, the hoist operator clears the helicopter away from the vessel, usually left but sometimes back. Maintain this position until the survivor is in the cabin and the tag line is either retrieved or discarded and the crewmember has reported ready for forward flight.

g. The tag line will be used in lieu of the hoist cable to lower small items to a boat. The item to be lowered will be attached to the snap link with the weight. Use the same procedures as above for delivery of the tag line to small and large vessels. The weak link end of the tag line will be attached to a cabin tie-down ring.

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. Ensure 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 search checklist in Annex A. 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/MH-53 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 ensures a thorough search of the objective area. Use 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.

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

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 individnal in a life jacket is almost impossible to detect unless a signalling device is used; therefore, a dstection range of one-fifth nautical mile should be used under this or similar circumstances.

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.

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.

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.

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. Maintain above 50 kts if possible. Refer to aircraft dash one for single engine capability and, if higher, use as a minimum airspeed. If required to go below 50 kts for search reasons, ensure that you have an escape route available should an emergency occur.

(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."

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.

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 seach difficult
Creeping Line Search	Easy nav Versatile Long, straight legs Follow-on Search easy	Starts at corner Only one nav update
Parallel Arc	Accurate track spacing Versatile Easy nav, easy flying	Requires nearby nav aid

Figure 17-4. Search Pattern 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.

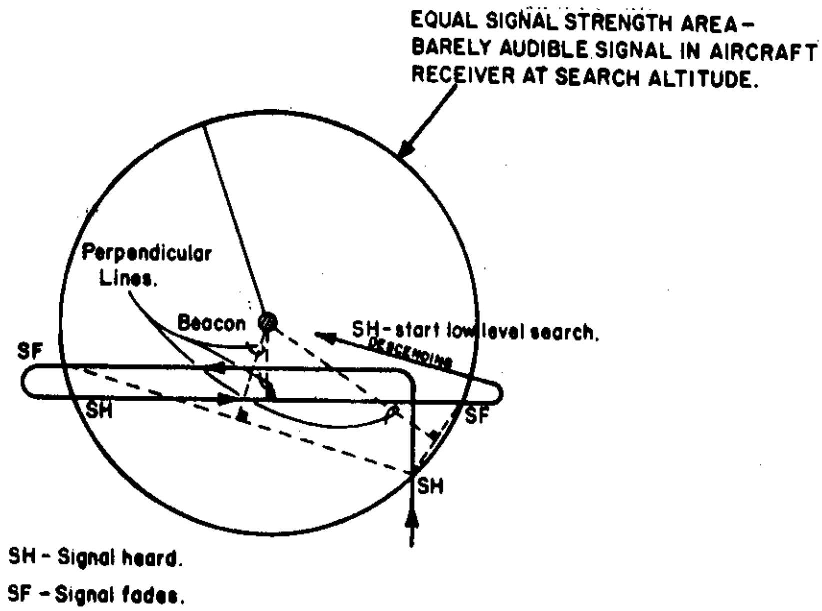


Figure 17-5. Narrowing Search Area—"Boxing-In" Technique.

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.

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 missing 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.

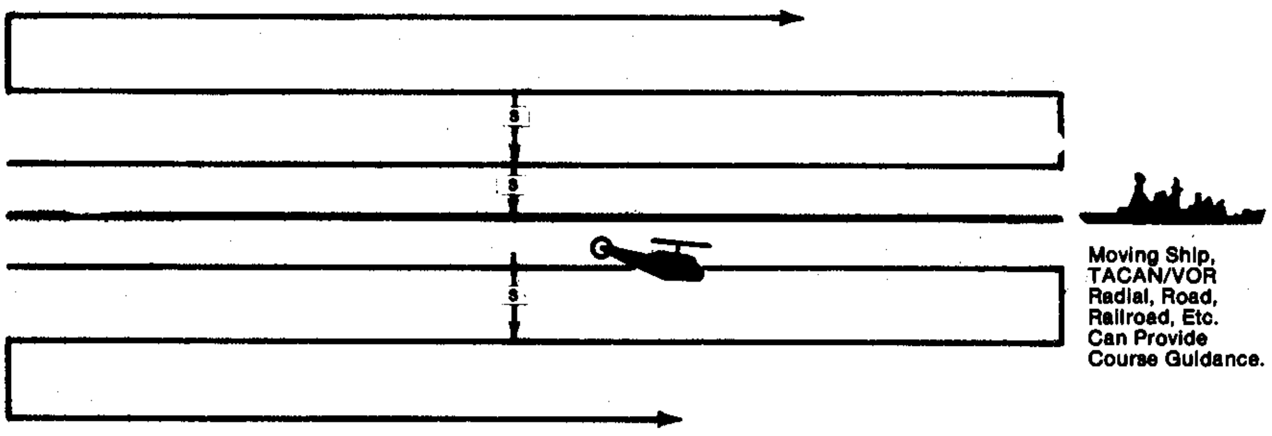
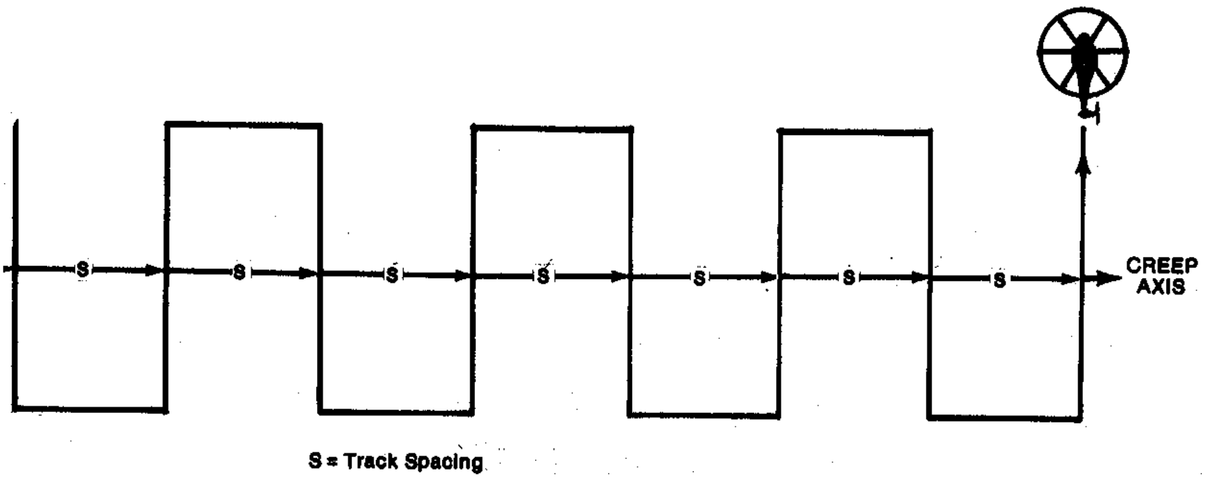


Figure 17-7. Parallel Search Pattern.

(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.



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.

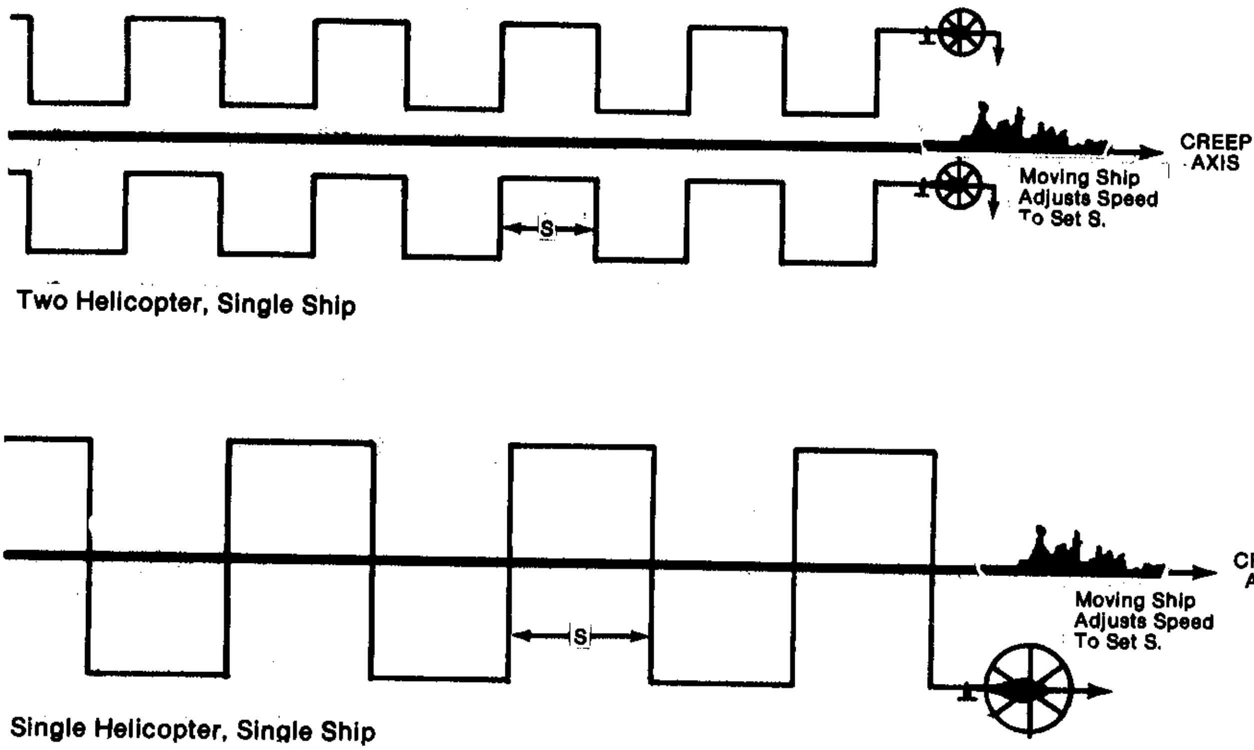


Figure 17-9. Multiple, Coordinated Creeping Line Patterns.

(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 searcb objectives of area and track spacing are met.

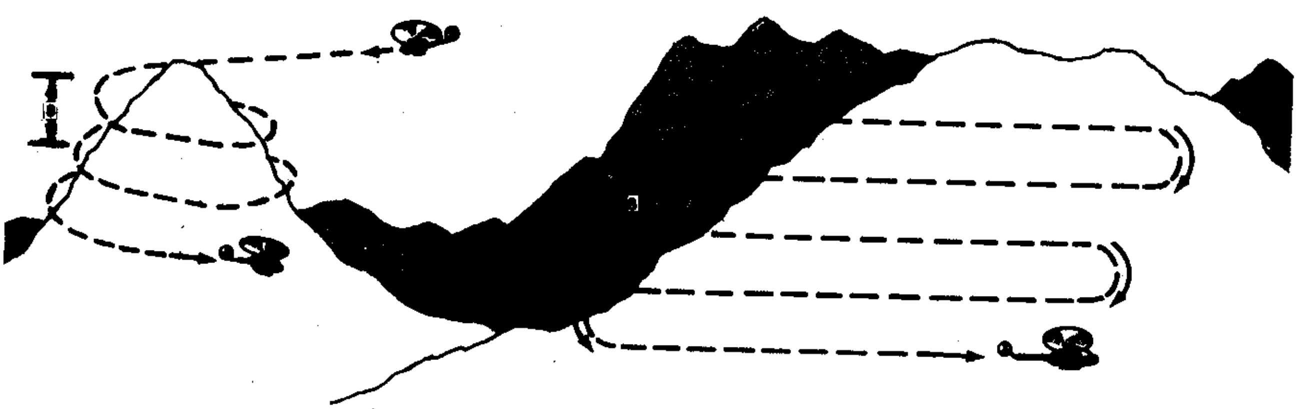
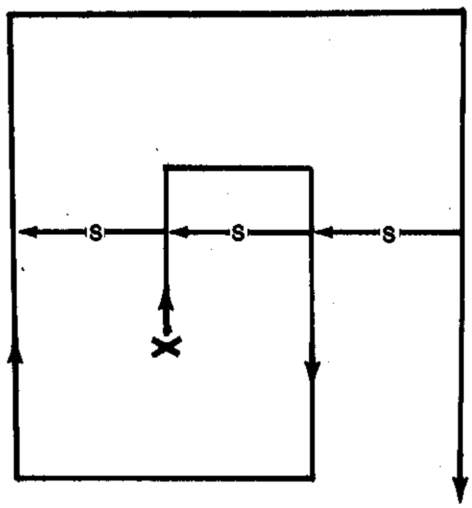


Figure 17-10. Contour Search Patterns.

(a) The Contour Search (figure 17-10) 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.

(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.



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.

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.

	2		4		6		8		12	
SEARCH RADIUS	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.

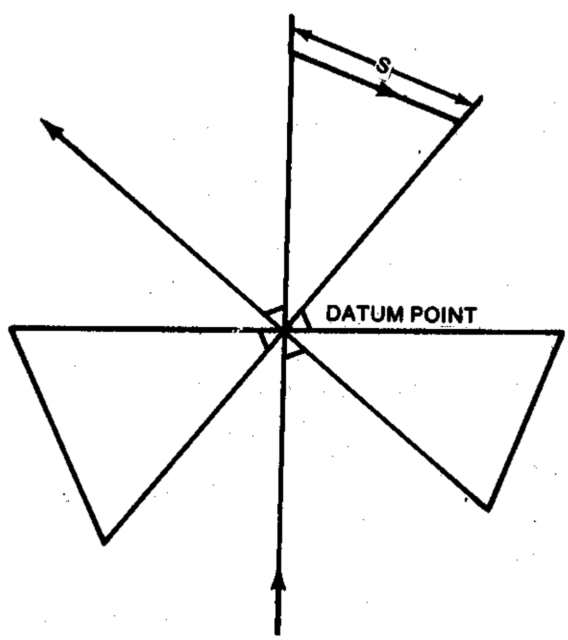


Figure 17-14. Typical Sector Search (8 Sections).

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 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.

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.

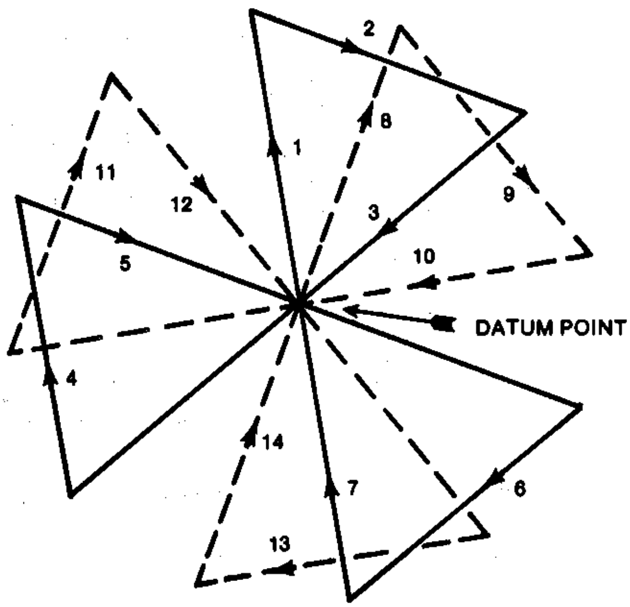


Figure 17-15. Alternate Sector Search Pattern (Equilateral Triangles).

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)	6-12	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).

(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.

e. Parallel Arc (Figure 17-17): This pattern is used by search aircraft for areas which have DME, TACAN, VORTAC, or similar distance navigation net coverage. It gives the benefit of accurate track guidance and is particularly useful in areas wherein the terrain is flat and homogeneous (i.e. all trees; barren; or, snow covered). Areas with excessive winds that make some of the DR search patterns difficult to navigate also lend themselves to this type of search pattern.

(1) The parallel arc consists of a series of DME arcs flown between the two radials bounding the search area. Track spacing, in miles, is equal to the increase/decrease in DME on successive arcs.

(2) Once the search area is plotted, four radial/DME fixes can be determined to define its boundaries. The pattern is flowr from radial to radial along the selected arcs.

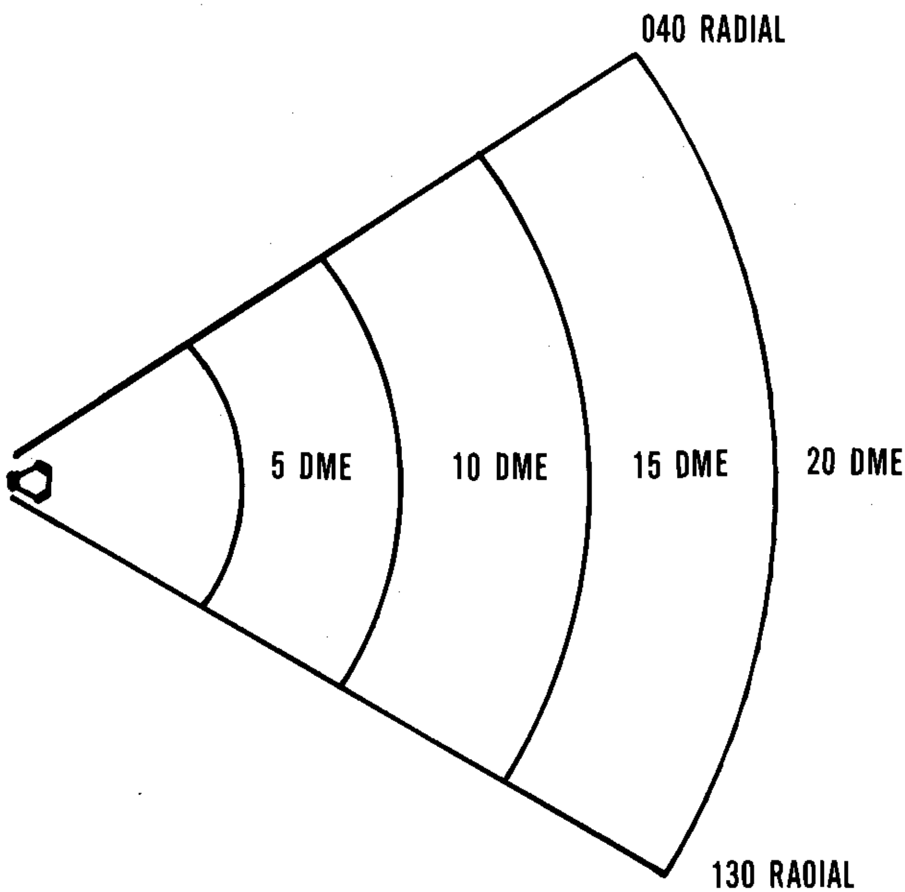


Figure 17-17. Parallel Arc.

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 (using ECHO codes) 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.

SAR-ON-SCENE PROCEDURES

1. RESPONSIBILITY. Commanders will ensure 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 ensure 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. Trespass by SAR personnel is excused or justified if it is required by necessity.

6. MARKING AIRCRAFT WRECKAGE. Obliterating or marking abandoned USAF aircraft wreckage is the responsibility of base commanders (reference AFR 127-4). 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. 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 proper 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 perform cargo sling operations and document the discrepancy in the AFTO Form 781A. Cargo sling operations using the Shepard's hook 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 ensure 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 taut 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 increasing 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 at or below 500 feet AGL.

(4) The radar altimeter when installed can be of great value during sling operations. A good technique when operating over level terrain with a 40 foot sling, is to 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) Under normal circumstances, flight controls should not be transferred while the cargo sling is armed. If a requirement exists to transfer controls with the sling armed, extreme caution should be taken by the pilot assuming control.

(4) Use extreme caution when using cyclic stick switches if the cargo sling is armed to preclude inadvertant load release.

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. At the AC's discretion the hookup person may be positioned at the two o'clock position until cleared in for the hook up. 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 or helmet with visor down for eye protection.

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 ensure 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) 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.

(b) 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 ensure 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) Ensure 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) Ensure 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, ensure 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, witb 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) Ensure 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.

(1) The hookup person should ensure that tbe 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 dsvices, longer sling, trapped water) may change the flight characteristics of the module and require a reduced airspeed.

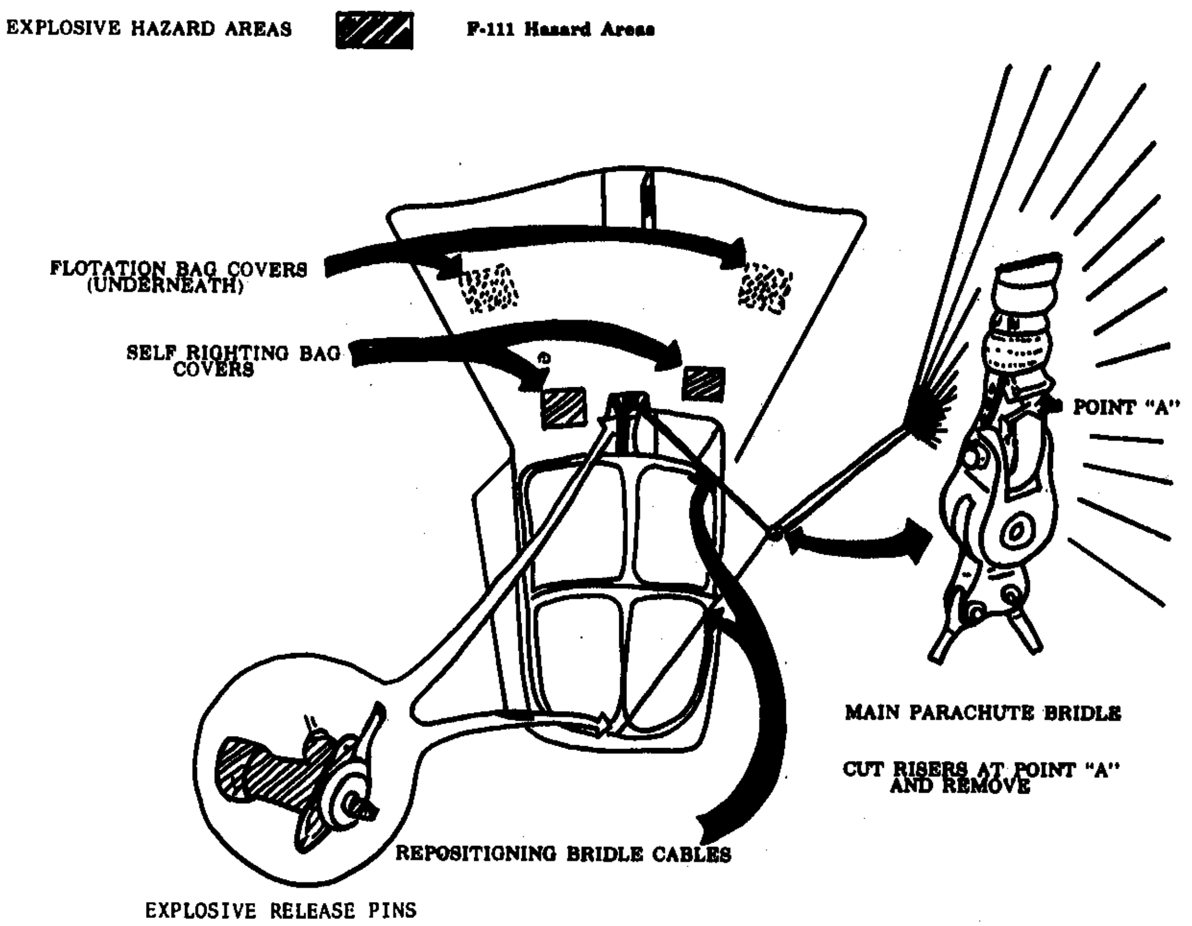
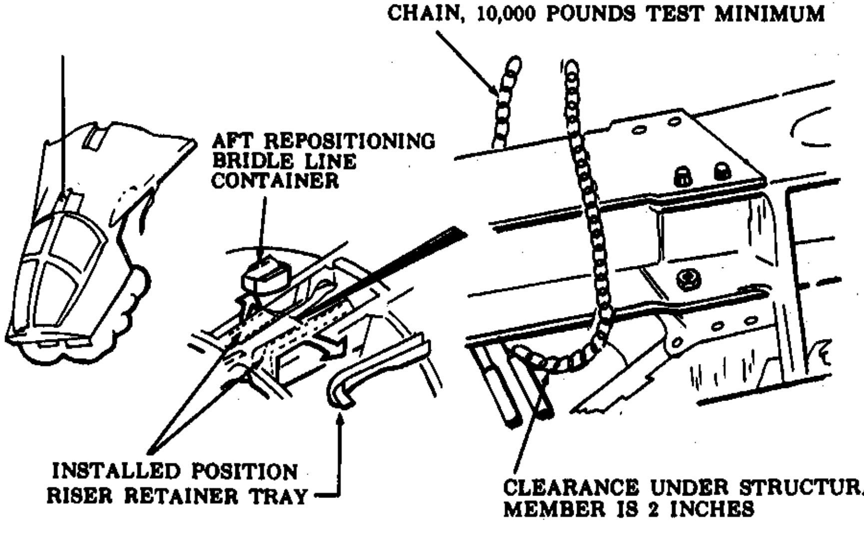


Figure 18-1. F-111 Module Explosive Hazard Areas.

NOTE: THIS IS THE ONLY METHOD OF TRANSPORTING THE MODULE. THE MODULE WILL RIDE 45 DEGREES NOSE DOWN AT LOW AIRSPEEDS.



NOTE: BRIDLE LINE CONTAINER AND RISER RETAINER TRAY ARE CONSTRUCTED OF PLASTIC AND EASILY REMOVED.

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

Chapter 19

OPERATIONAL/REMOTE LANDING SITE PROCEDURES

19-1. General. This chapter provides guidance for the successful accomplishment of landing site 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 reste 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. (See paragraph 6-77.)

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 tbe 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. Operational Landing Site Procedures:

a. Operational sites are defined as those sites where operations are conducted on a recurring basis in performance of unit missions (nontraining).

b. An "operational site evaluation" (OSE) will be made to each operational site prior to commencing a final approach to a landing/hover if:

(1) Out-of-ground-effect (OGE) hover power is not available at the landing site, or

(2) When deemed necessary by the aircraft commander.

EXCEPTION: An OSE is not applicable to operations into missile sites. Refer to "Missile Site Evaluation," paragraph 23-6f.

c. The operational site evaluation will be flown using the same approach course. The aircraft will be configured for landing prior to executing the OSE. The OSE will be flown at a minimum of 50 KIAS and a minimum of 50 feet above the highest obstacle at the landing site. For cargo sling operations, the OSE will be flown at a minimum of 300 feet AGL. A power available check will be performed prior to commencing final approach.

d. These procedures apply only to operational sites which are everyday, presurveyed sites. The purpose of these procedures is to aid crewmembers in recognizing unforseen, dangerous situations prior to committing themselves for final approach.

19-5. 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 belicopter 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 bave 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 all of these conditions.

19-6. Preparation. During premission preparation, use all available parameters to ensure 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 responsibilties:

(a) Pilot Flying. The pilot will verbalize his/her site evaluation and plan of action; request input from other Crewmembers; 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 tbe 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 power 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. Power required/power available 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 crewmember. Any time 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 crewmembers 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

19-7. 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. Complete power available checks prior to commencing the low reconnaissance if required.

(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 6-77)
(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 items reviewed on the high reconnaissance.

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 19-8e(3)).

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

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

(4) During a PAVE LOW 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 evaluats 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/inertial/CAC 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?

19-8. 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 the type approach being flown.

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. 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 along the length of 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 instrumente during the approach is necessary to ensure 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 ensure 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 10 knot wind blowing down a 5 degree slope will result in a downdraft component of approximately 88 fpm. A 40 knot wind blowing down a 30 degree slope will result in a downdraft component of approximately 2025 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 ensure 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/power 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.

(6) The power required performance charts in applicable flight manuals are figured for a hover over level, non-porus surfaces. When landing in unprepared sites, aircrews should be aware of increased power requirements when hovering over tall grass, slopes, and obstacles in close proximity to the aircraft.

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. To avoid power settling, do not exceed the vertical velocity limits for the type approach being flown. Constantly monitor main rotor RPM to prevent main rotor overspeeds.

(b) Tactical approaches will only be performed during:

1. Tactical training maneuvers.

2. Missions where the risk of flying a normal rectangular pattern or turning approach would be greater than maneuvering directly for an approach or landing.

19-9. 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 tbat 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 crewmember to the ground to perform a survey. This crewmember 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.

19-10. 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.

19-11. 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 ensure 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.

19-12. 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 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

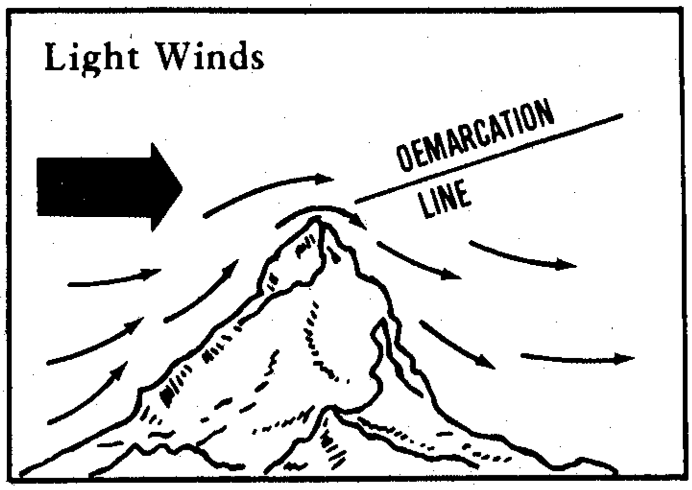


Figure 19-1. Light Winds.

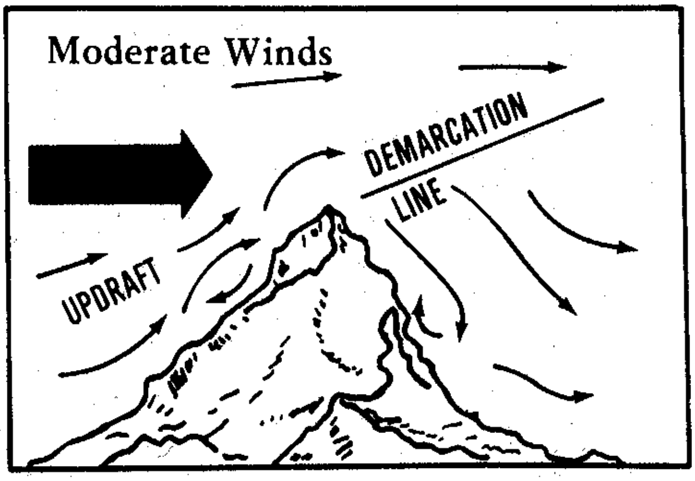


Figure 19-2. Moderate Winds.

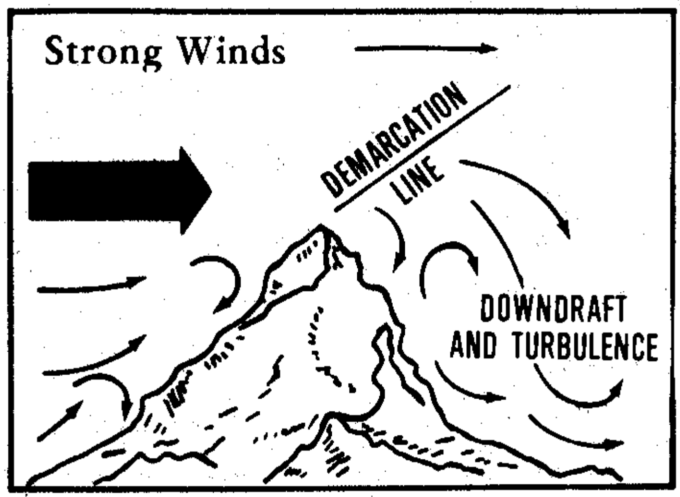


Figure 19-3. Strong Winds.

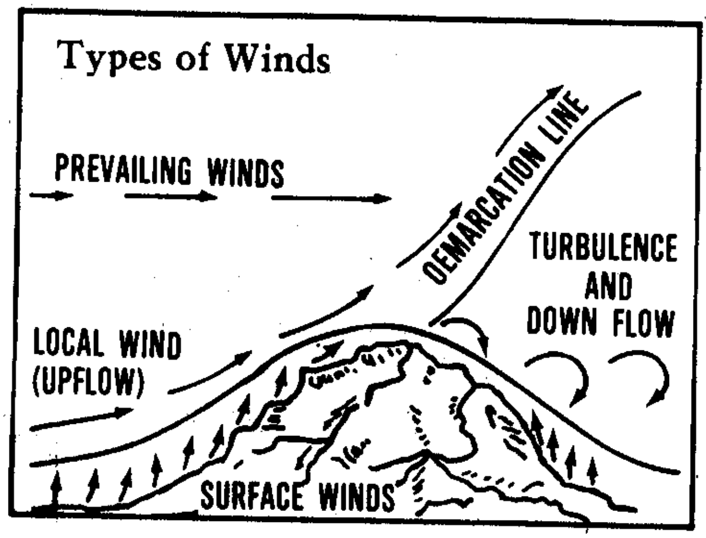


Figure 19-4. Types of Winds.

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.

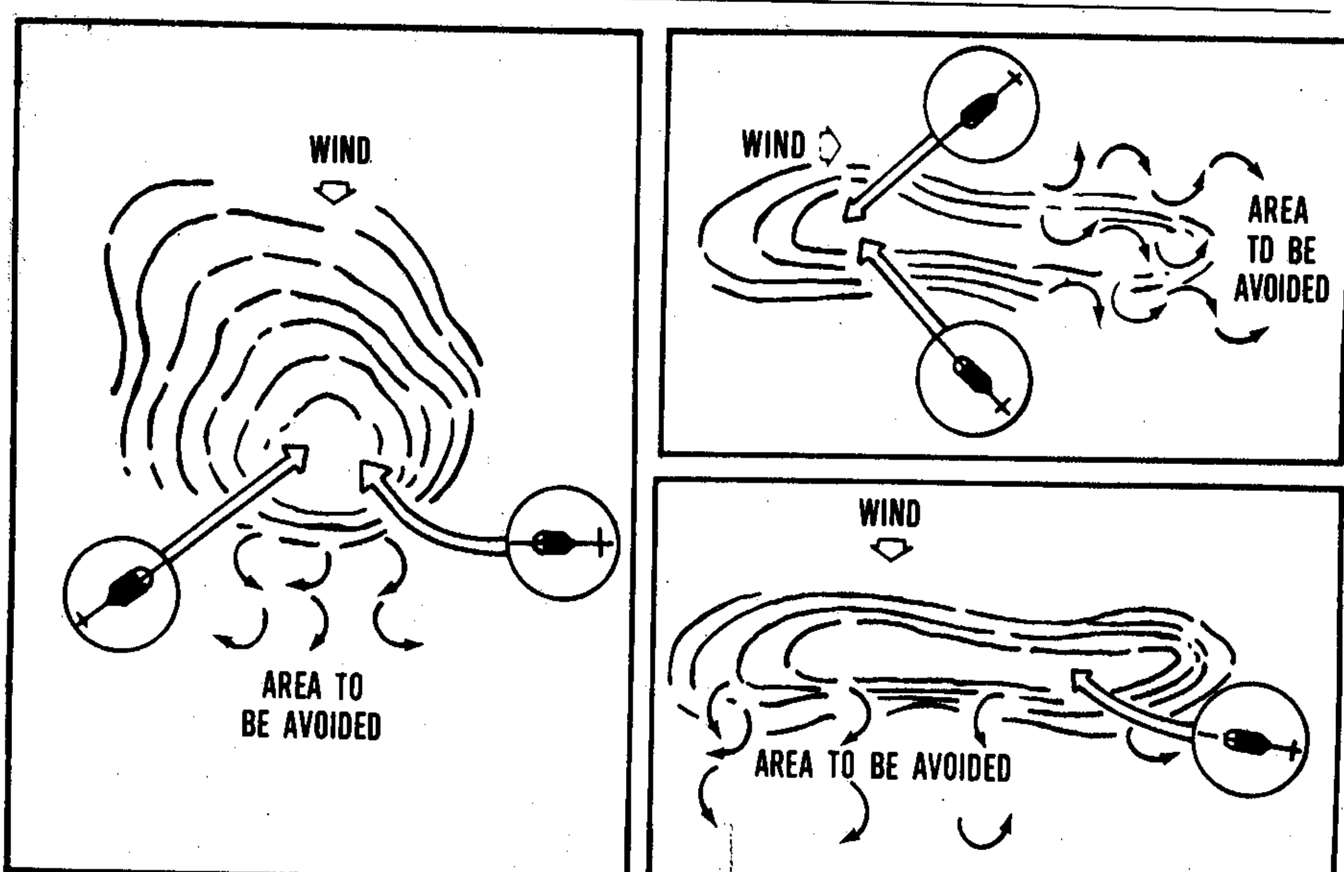


Figure 19-5. Approach Paths and Areas To Avoid.

19-13. 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, recovery can only be accomplished by lowering the collective and nose to gain airspeed (reducing power required). 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. See paragraph 6-78.

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 crewmembers 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 a steep approach, regardless of 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.

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.

19-14. 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 artificially 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 19-6).

(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.

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 AND READ OFF THE DA CORRECTION VALUE
3. ADD THIS CORRECTION TO THE ORIGINAL DA VALUE (OBTAINED USING FREE AIR TEMPERATURE AND PRESSURE ALTITUDE).

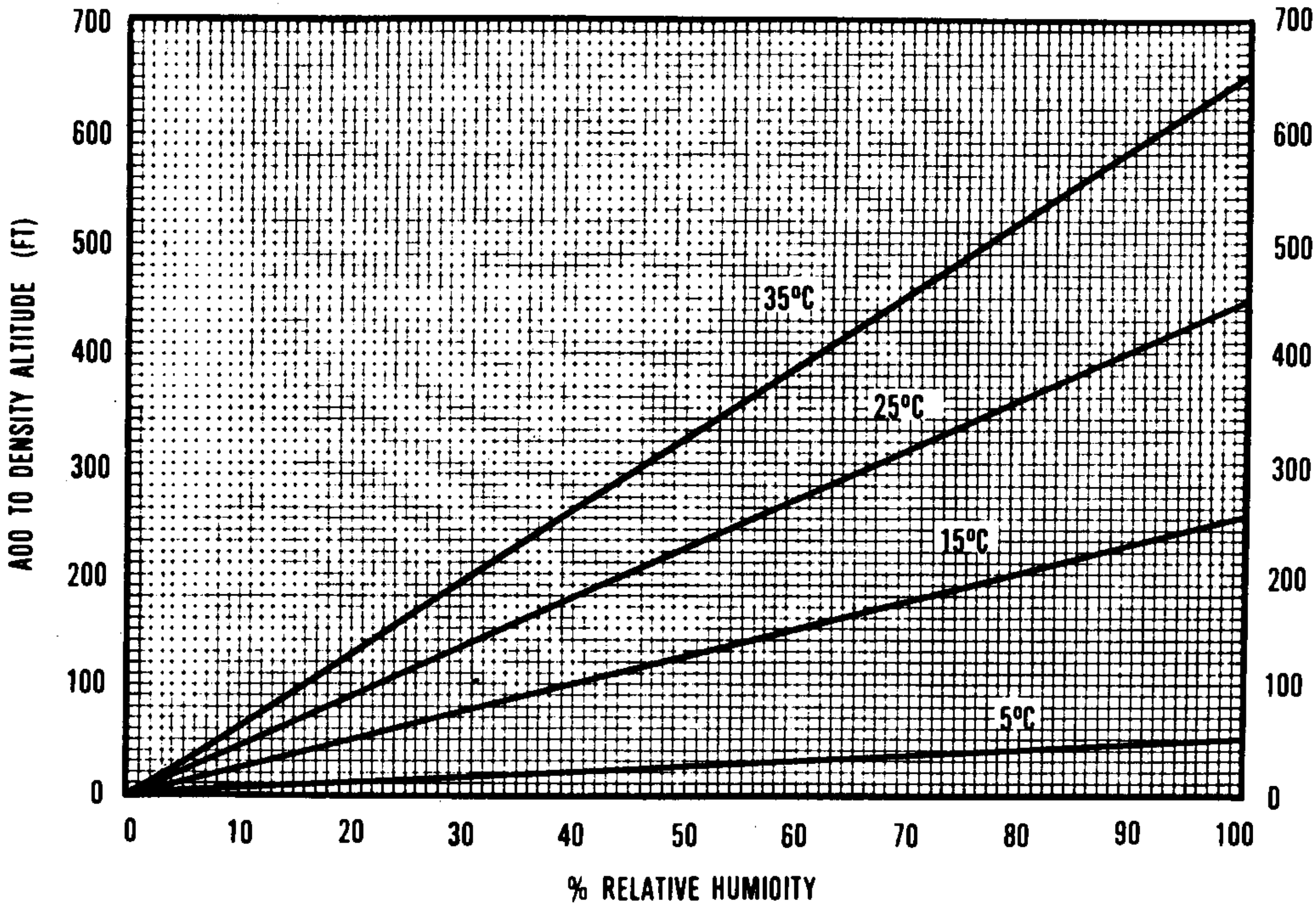


Figure 19-6. Density Altitude Correction Based On Relative Humidity.

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 go around. In order for the recovery to be successful, the pilot must recognize the situation early enough to ensure 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 cases 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 tha 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.

19-15. Obstacle Clearance. The aircraft commander has the ultimate responsibility for obstacle clearance. If possible, use additional crewmembers as scanners to assist the pilot. Ensure 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 obetacles, 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").

19-16. 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.

19-17. Night Approaches to Unprepared Areas. (Not applicable to NVG/MH-53 operations.) 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 crewmembers on specific approach procedures, pilot's intention, significant terrain features, specific crew requirements such as scanning and other pertinent facts. See paragraph 5-17 for altitude restrictions.

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 pilot not flying 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.

19-18. 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.

19-19. 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 19-8 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 19-8. 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.

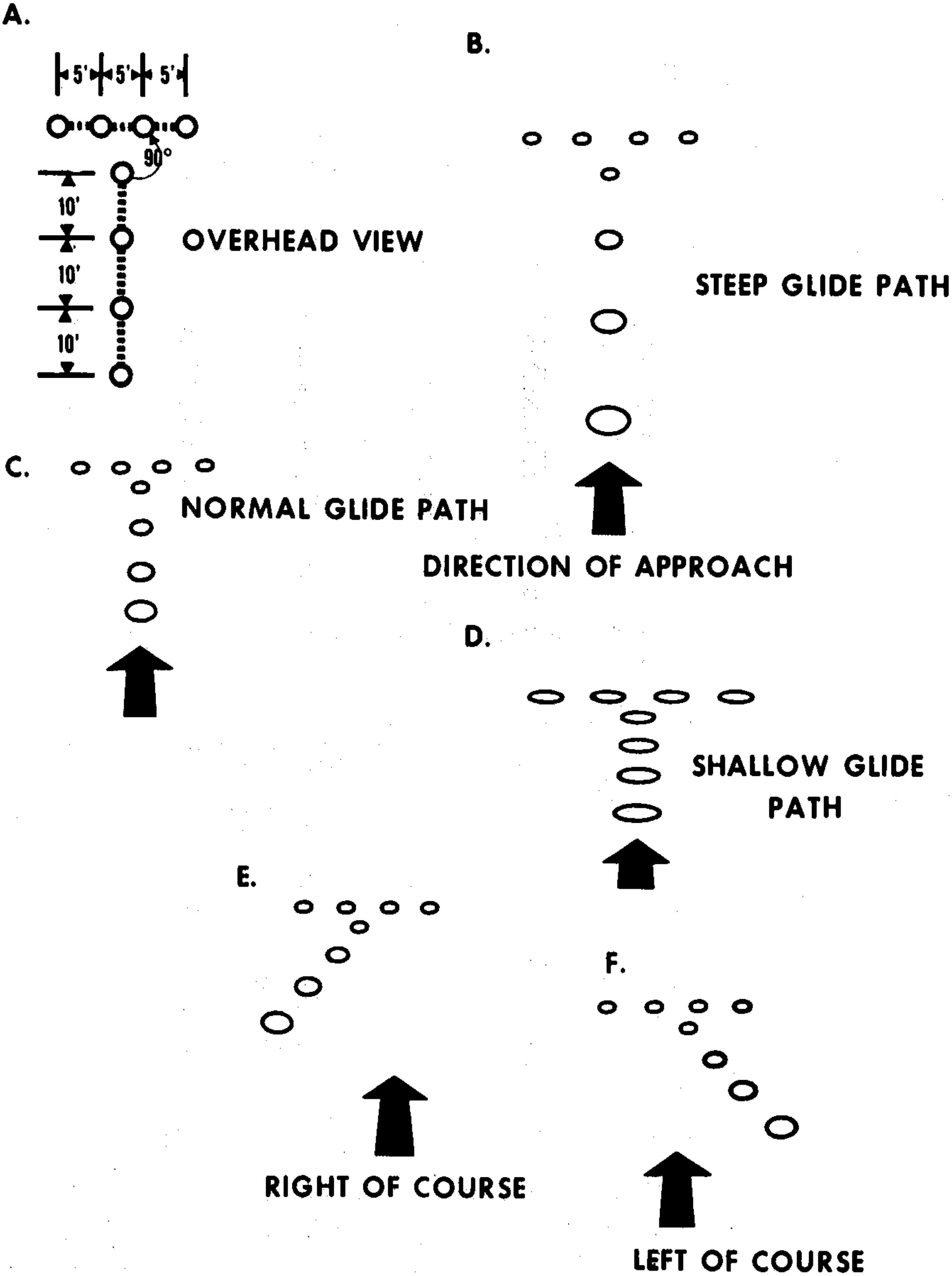


Figure 19-7. Approach to Lighted T Pattern in Landing Zone.

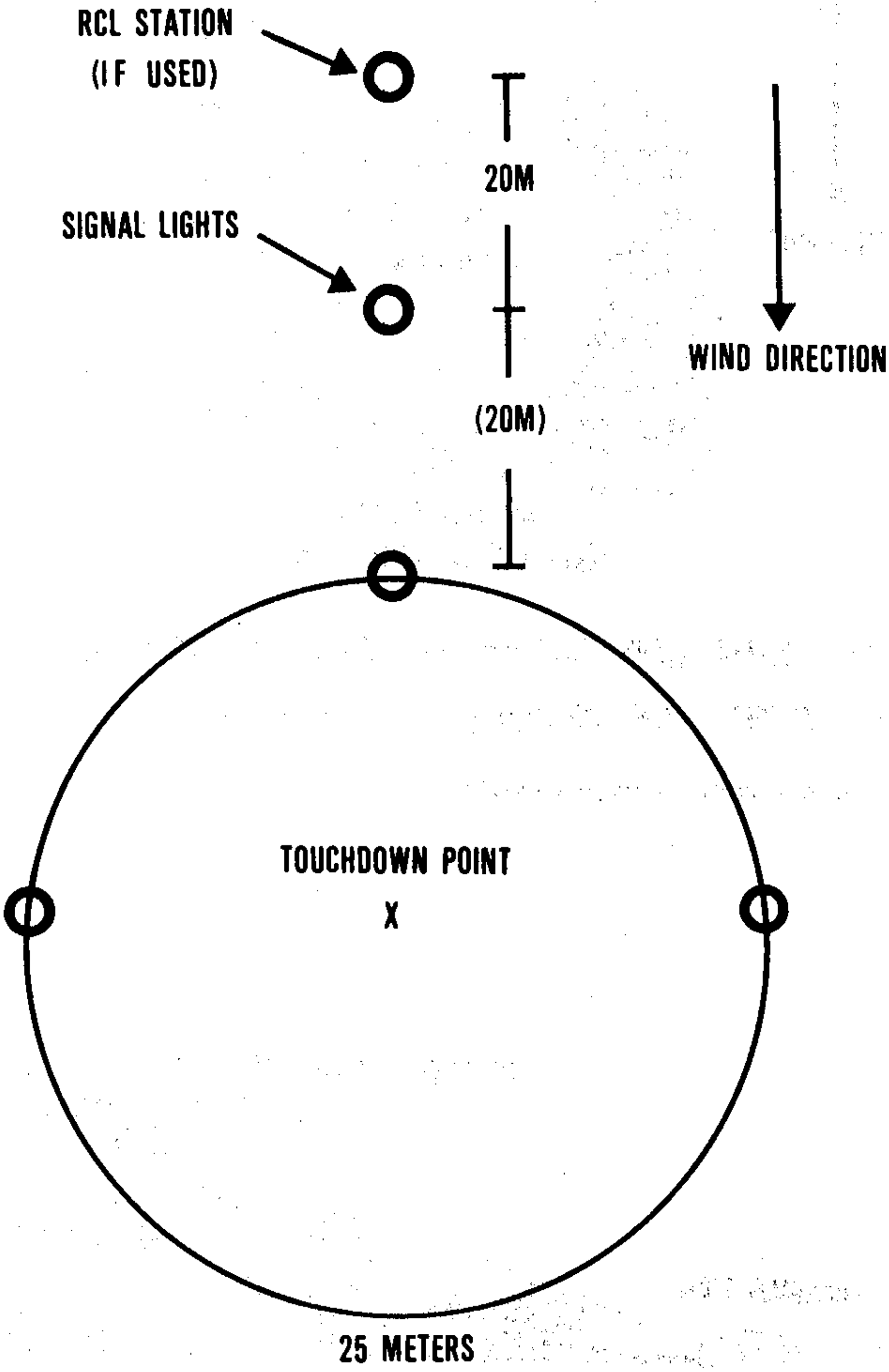
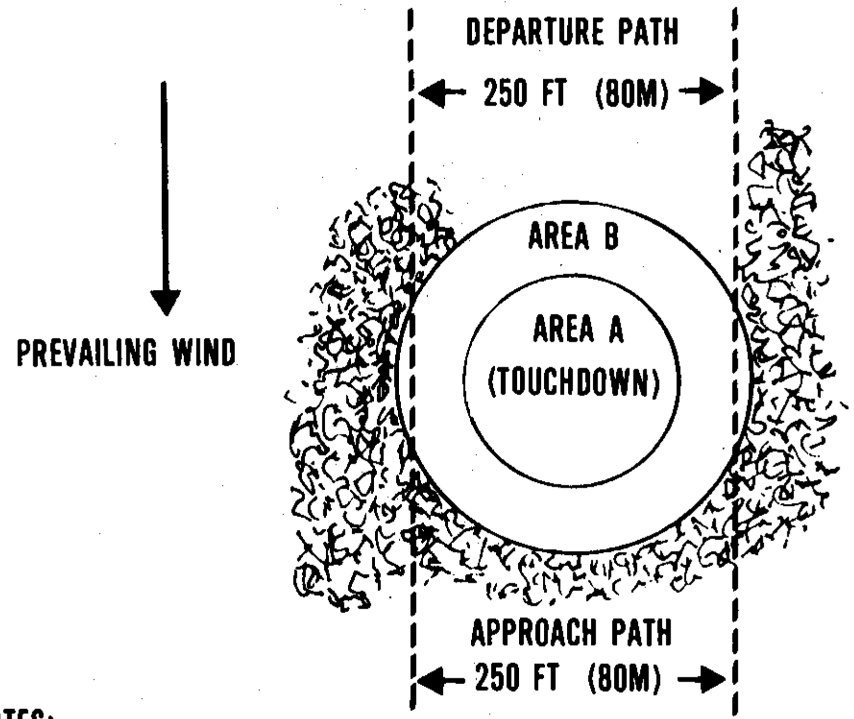


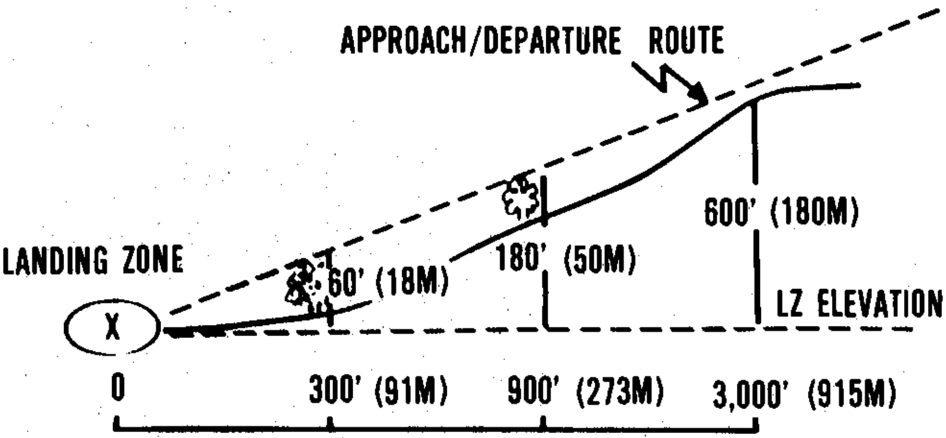
Figure 19-8. Typical Helicopter Landing Zone Pattern for Night Operations - Inverted Y.



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).



NOTE: GLIDE/CLIMB RATIO 1:5

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