CAUTION

It has been established that during flight, critical combinations of engine and rotor conditions coupled with rapid control inputs, may cause rotor blade fuselage contact. Avoid retarding speed selectors prior to entering autorotations and/or rapid reduction of collective pitch, especially at reduced rotor rpm. Upon entering autorotation, avoid abrupt cyclic movements. Excessive forward cyclic could cause the main rotor blades to contact engines and/or cockpit.

BEFORE LANDING.

The pilot initiates this check by stating "Landing gear - (as required), Before Landing checklist." The copilot responds, "Landing gear - (as required)", positions the gear handle and silently completes items 1 through 6. He verbally calls item 7.

NOTE

A maximum power available check is required prior to the first landing in a remote area and prior to operation at or near the maximum capability of the helicopter.

1. Fuel - CHECKED. (CP)

CAUTION

If one fuel low level caution light comes on, turn on all available boost pumps and open the crossfeed. If both fuel low caution lights come on, turn on all available boost pumps, open the crossfeed and avoid nose-up attitudes greater than 6 degrees.

2. Engine and transmission instruments - NORMAL. (CP)
3. Parking brake - AS REQUIRED. (CP)

NOTE

Parking brake should be locked when landing with nose wheel lock engaged.

4. Speed selectors - 103% N_r. (CP)

   Use maximum N_r on final approach as required.

5. AN/ALE-20 arming switch - AS REQUIRED. (CP)
6. Landing gear - AS REQUIRED. (CP)

   Check landing gear position indicators.

7. "Before Landing checklist completed." (CP)

TRAFFIC PATTERN.

The pilot initiates this checklist after takeoff by stating "Landing Gear - (as required), Traffic Pattern Checklist." The copilot responds, "Landing gear (as required)," verbally confirms the gear handle is positioned properly and silently completes item 1 through 4, calling out item 5.

NOTE

The landing gear will remain down during all multiple land traffic patterns and will remain up during all multiple water traffic patterns.

1. Engine and Transmission Instruments - CHECKED. (CP)
2. Landing Gear - INDICATORS CHECKED. (CP)
3. Lights - AS REQUIRED. (CP)
4. Speed Selectors - 103% Nr. (CP)
5. "Traffic Pattern Checklist Completed." (CP)

GROSS WEIGHT AND CENTER OF GRAVITY LIMIT.

The landing gross weight and center of gravity of the helicopter are important factors to be considered when determining the feasibility of a helicopter landing. In all instances, the fuel load, equipment, cargo, and personnel should be situated so as not to disturb the desired center of gravity of the helicopter. Refer to WEIGHT LIMITATIONS, section V, to insure that the maximum gross weight for landing is not exceeded.

LANDING.

APPROACH AND LANDING.

During the final approach phase, recheck the landing gear and beep speed selectors to maximum N_r, if operational requirements dictate. Fly a pattern that will provide an approach and landing appropriate for the landing site (see figure 2-9). On final approach reduce airspeed and establish desired approach angle to the landing site. Airspeed and altitude should be dissipated simultaneously to attain a hover over the intended landing site, then slowly reduce collective for a vertical descent and landing. The approach may also be made to a touch-down without coming to a hover.

WARNING

High rates of descent combined with low forward airspeed should be avoided. For hazards associated with power settling refer to Section VI.

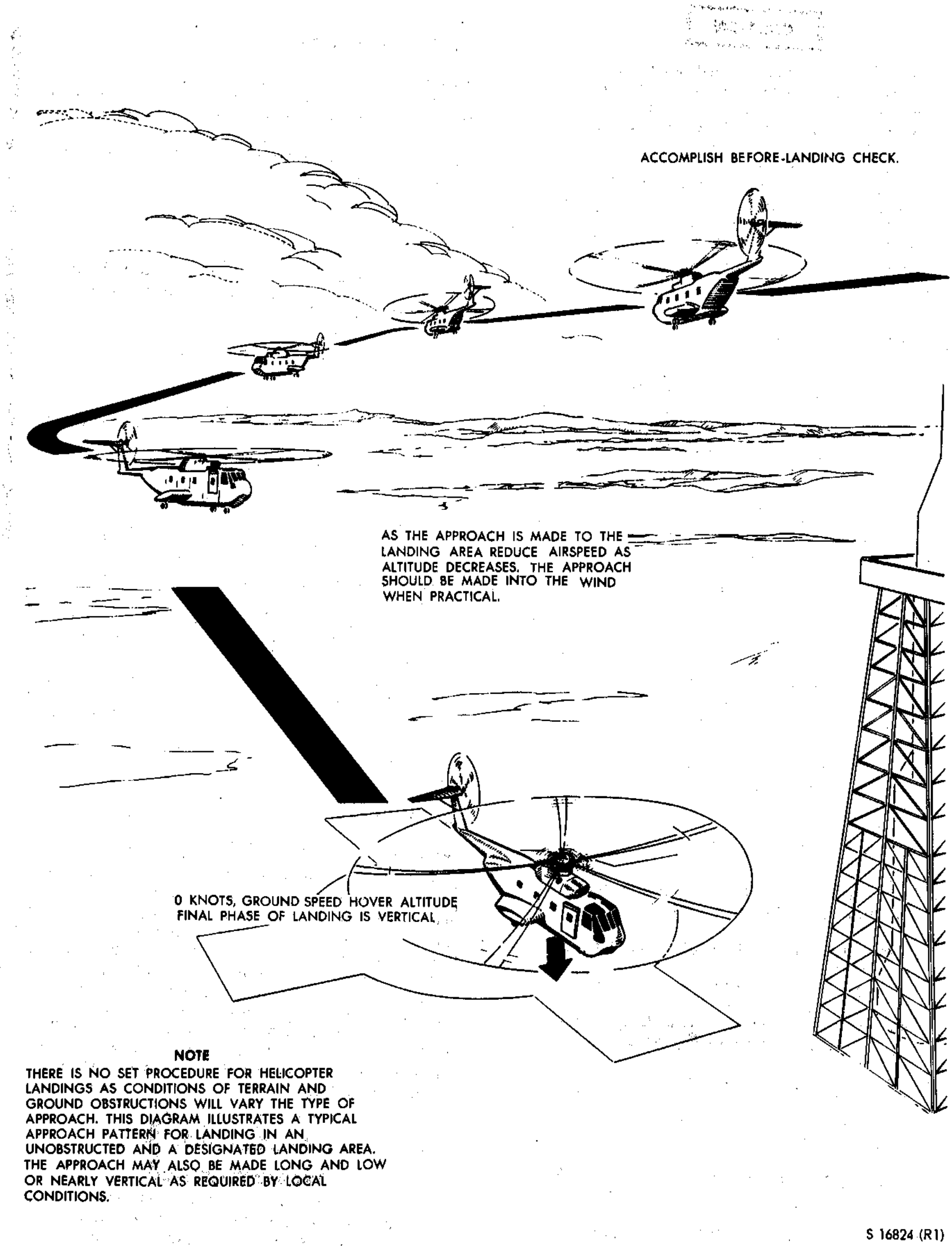


Figure 2-9. Normal Landing (Typical)

CAUTION

Do not exceed 12 degree, nose-up attitude at the point of ground contact. At 15 degree, nose-up attitude, the tail pylon will contact the ground on landing.

CAUTION

Those helicopters equipped with a refueling probe normally will not accomplish takeoffs and landings with the probe extended.

TOUCH AND GO LANDINGS.

For touch and go landings follow the procedures for a normal running landing. Check collective lever in the minimum position, speed selectors forward, then follow the procedures for a normal running takeoff.

RUNNING LANDING.

Before attempting a running landing, the surfaces should be checked from low altitude to determine the feasibility of accomplishing the landing. Running landings are usually accomplished from a shallow approach when the helicopter cannot be hovered due to a high gross weight or altitude. Running landings should be accomplished with the nose wheel unlocked and parking brakes off. Adjust collective pitch, as necessary, to maintain the desired approach angle and dissipate speed gradually throughout the approach so the landing can be accomplished while maintaining translational lift. Establish a straight track over the ground and a shallow approach with a slow rate of descent. Use tail rotor pedals to maintain heading in direction of track and cyclic stick to control drift. As the helicopter approaches the ground, increase collective pitch slightly to reduce rate of descent and airspeed to minimum value compatible with gross weight and altitude conditions, and maintain a steady attitude. Aircraft should not exceed 40 knots ground speed during touchdown. As the wheels contact the ground, hold the cyclic stick steady and slowly decrease collective pitch to minimum. The helicopter should be stopped with the wheel brakes.

CAUTION

To avoid skidding and blowing tires, reduce collective pitch to minimum before applying brakes.

CROSSWIND LANDING.

CAUTION

Crosswind landings are prohibited in winds exceeding 35 knots. Crosswind landing procedures are the same as into the wind vertical landing procedures, except the cyclic stick must be displaced into the wind to prevent sideward drift. The cyclic displacement should not be released on the touchdown as this will reduce the force holding the helicopter in a vertical position. Under extreme conditions, crosswinds could result in the helicopter being overturned. During crosswind landings, with the wind from the right, it may be noted that tail rotor control may run out. This happens at high gross weights when leaving an approach and entering a hover. This is a result of weather vaning and rotor torque which causes the helicopter to turn to the right.

REMOTE AREA OPERATIONS.

MOUNTAIN AND ROUGH TERRAIN FLYING.

Many helicopter missions require flight and landings in rough and mountainous terrain. Refined flying techniques along with complete and precise knowledge of the individual problems to be encountered is required: Landing site condition, wind direction and velocity, gross weight limitations, and effects of obstacles are but a few of the considerations for each landing or takeoff. In a great many cases, meteorology facilities and information are not available at the site of intended operation. The effects of mountains and vegetation can greatly vary wind conditions and temperatures. For this reason each landing site must be evaluated at the time of intended operation. Altitude and temperature are major factors in determining helicopter power performance. Gross weight limitations under specific conditions can be computed from the performance data in the Appendix. A major factor improving helicopter lifting performance is wind. Weight carrying capability increases rapidly with increases in wind velocity relative to rotor system. However, accurate wind information is more difficult to obtain and more variable than other planning data. It is therefore not advisable to include wind in advanced planning data except to note that any wind encountered in the operating area may serve to improve helicopter performance. In a few cases operational necessity will require landing on a prepared surface at an altitude above the hovering capability of the helicopter. In these cases a roll-on landing and takeoff will be necessary to accomplish the mission. Data for these conditions can be computed from the charts in the Appendix.

WIND DIRECTION AND VELOCITY.

There are several methods of determining the wind direction and velocity in rough area. The most reliable method is by the use of smoke generators. However, it must be noted that the hand held day/night distress signal and the standard ordnance issue smoke hand grenade are satisfactory for wind indication but constitute a fire hazard when used in areas covered with combustible vegetation. Observation of foliage will indicate to some degree the direction of the wind, but is of limited value in estimating wind velocity. Helicopter drift determined by eyesight without the use of navigational aids is the first method generally used by experienced pilots. The accuracy with which direction may be determined through the "drift" method becomes a function of wind velocity. The greater the wind value the more closely the direction may be defined.

CAUTION

Depending on wind velocity, the apparent airspeed/ground speed relationship changes when turning downwind. After the turn less airspeed is required to maintain ground speed. Reducing airspeed may result in loss of translational lift which increases the power required to maintain altitude. When operating close to the surface, especially during downwind maneuvering, airspeed and power required must be monitored closely.

LANDING SITE EVALUATION.

Five major considerations in evaluating the landing area are: (1) height of obstacles which determine approach angle, (2) size and topography of the landing zone, (3) possible loss of wind effect, (4) power available, and (5) departure route. The transition period is the most difficult part of any approach. As helicopter performance decreases, the transition period becomes more critical, and of necessity approaches must be shallower and transition more gradual. Therefore, as the height of the obstacle increases, larger areas will be required. As wind velocity increases so does helicopter performance; however, when the helicopter drops below an obstacle a loss of wind generally occurs as a result of the airflow being unable to immediately negotiate the change prevalent at the upwind side of the landing zone where a virtual null area exists. This null area extends toward the downwind side of the clearing and will become larger as the height of the obstacle and wind velocity increases. It is therefore increasingly important in the landing phase that this null area be avoided if marginal performance capabilities are anticipated. The null area is of particular concern in making a takeoff from a confined area. Under heavy load, or limited power conditions it is desired to achieve a significant value of forward velocity and translational lift prior to transitioning to a climb, so that the overall climb performance of the helicopter will be improved. If the takeoff cycle is not commenced from the most downwind portion of the area, and translational velocity achieved prior to arrival in the null area, a significant loss in lift may occur at the most critical portion of the takeoff. It must also be noted that in the vicinity of the null area nearly vertical downdrafts of air may be encountered, which will further reduce the actual climb rate of the helicopter. It is feasible that under certain combinations of limited area, high obstacles upwind, and limited power available, the best takeoff route would be either crosswind or downwind, terrain permitting. The effects of detrimental wind flow and the requirement to climb may thus be minimized or circumvented. Even though this is a departure from the cardinal rule of "takeoff into the wind", it may well be the proper solution when all factors are weighed in their true perspective. Never plan an approach to a confined area wherein there is no reasonable route of departure. The terrain within a site is considered from an evaluation of vegetation, surface characteristics, and slope. Care must be taken to avoid placing the rotors in low brush or branches. Obstacles covered by grass may be located by flattening the grass with rotor wash prior to landing. Power should be maintained so that an immediate takeoff may be accomplished should the helicopter start tipping from soft earth or a gear being placed in a hidden hole.

CAUTION

Extreme care must be taken to prevent the rotor blades from striking terrain or obstacles on either side of the helicopter.

CAUTION

When operating in the vicinity of any loose objects (i.e. signal panels, parachutes, debris), use extreme caution to preclude objects being blown up into the aircraft rotor system.

NOTE

The pilot should always maintain takeoff rotor speed on an unprepared surface until it has been determined that the surface will support the helicopter. This will permit immediate takeoff if the helicopter should start to tip over or sink into the surface.

Landing on Slippery Areas.

Landing on wet or icy areas in hazardous, and due caution must be exercised when landing or taxing. Brake action will tend to induce skidding.

EFFECTS OF HIGH ALTITUDES.

Engine power available at altitude is less, and operations can easily be in a situation of limited hovering ability. High gross weight at altitude increases the susceptibility of the helicopter to blade stall. Conditions that contribute to blade stall are high forward speed, high gross weight, high altitude, low rpm, induced G loading and turbulence. Shallower turns at slower airspeeds are required to avoid blade stall. A permissible maneuver at sea level must be tempered at a higher altitude. Smooth and timely control application and anticipation of power requirements will do more than anything else to improve altitude performance.

TURBULENT AIR FLIGHT TECHNIQUES.

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 the structural limits of the helicopter being exceeded. 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. It can be dangerous if severe and is normally associated with updrafts and downdrafts. It is created by moving air being lifted by natural or manmade obstructions. It is most prevalent in mountainous regions and is always present in mountains if there is a surface wind. Orographic turbulence is directly proportional to the wind velocity. It is found on the upwind of slopes and ridges near the tops, and extending down the downwind slope (figure 2-12). It will always be found on the tops of ridges associated with updrafts on the upwind side and downdrafts on the downwind side. Its extent on the downwind slope depends on the strength of the wind and the steepness of the slope. If the wind is fairly strong (15 to 20 knots) and the slope is steep, the wind will have a tendency to 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. Man made obstructions and vegetation will also cause turbulence. Extreme care should be taken when hovering near buildings, hangars, and similar obstructions. The best method to overfly ridgelines from any direction is to acquire sufficient altitude prior to crossing to avoid leeside downdrafts. If landing on ridgelines, (figure 2-10), the approach should be made along the ridge in the updraft, or select an approach angle into the wind that is above the leeside turbulence. When the wind blows across a narrow canyon or gorge, (figure 2-14), it will often veer down into the canyon. Turbulence will be found near the middle and downwind side of the canyon or gorge. When a helicopter is being operated at or near its service ceiling and a downdraft of more than 1.6 feet per second is encountered, the helicopter will descend. Although the downdraft does not continue to the ground, a rate of-

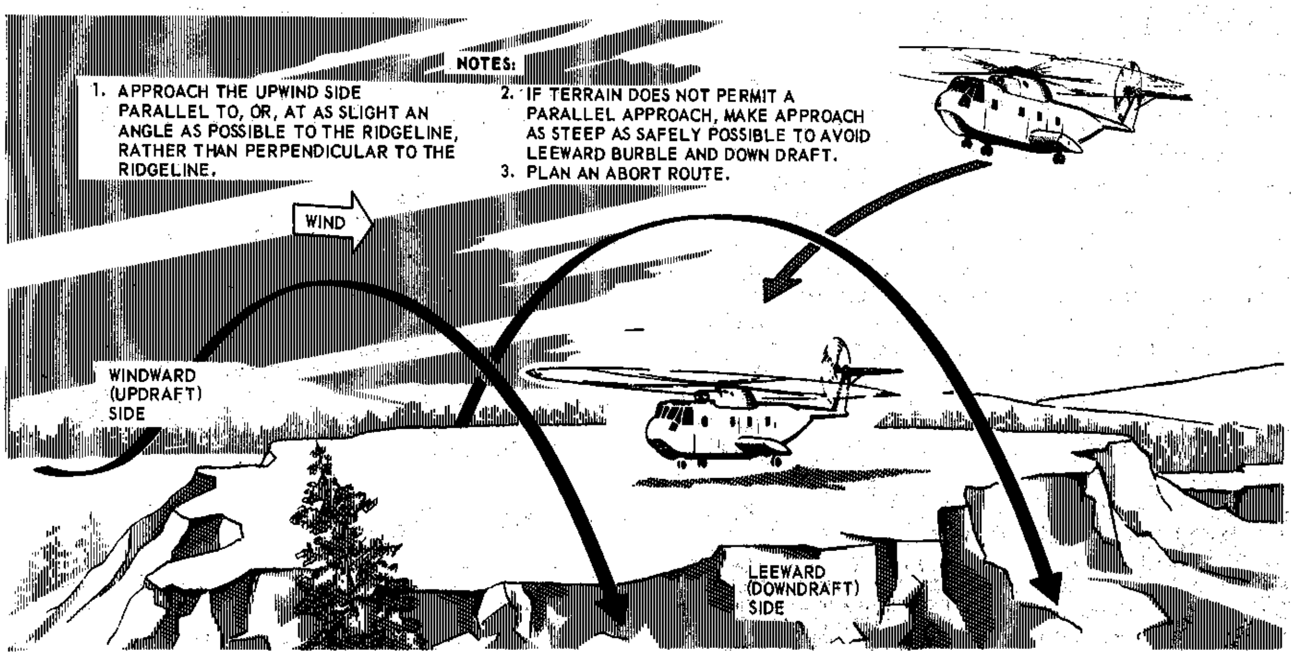


Figure 2-10. Wind Effect on Ridgeline Approach

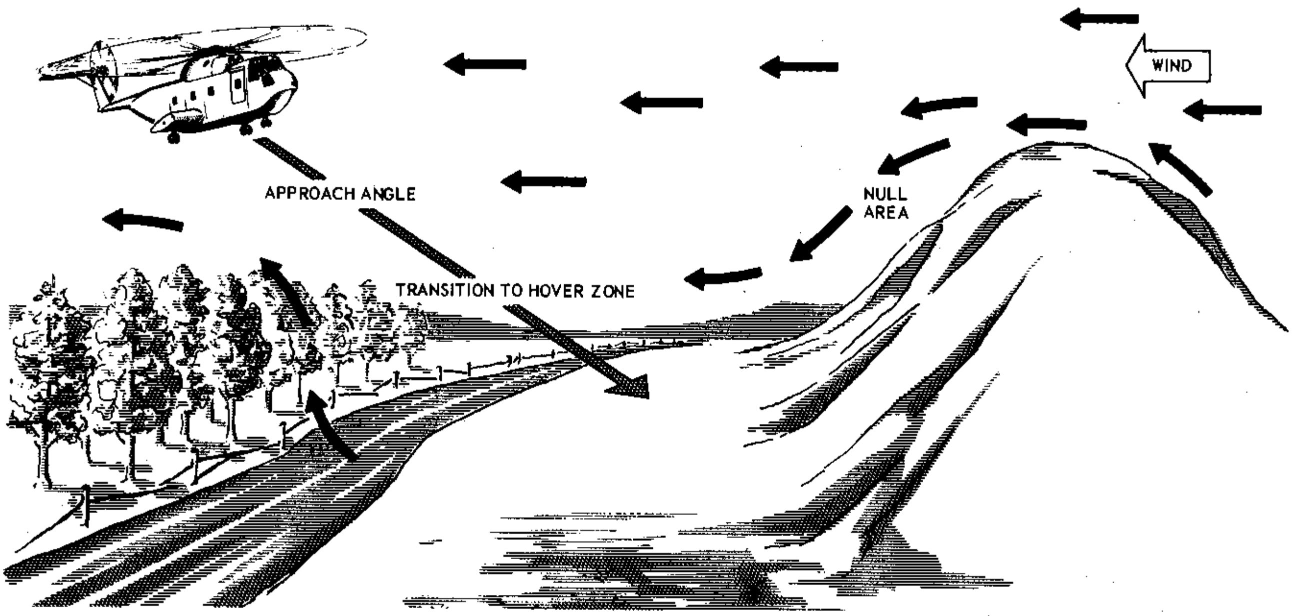
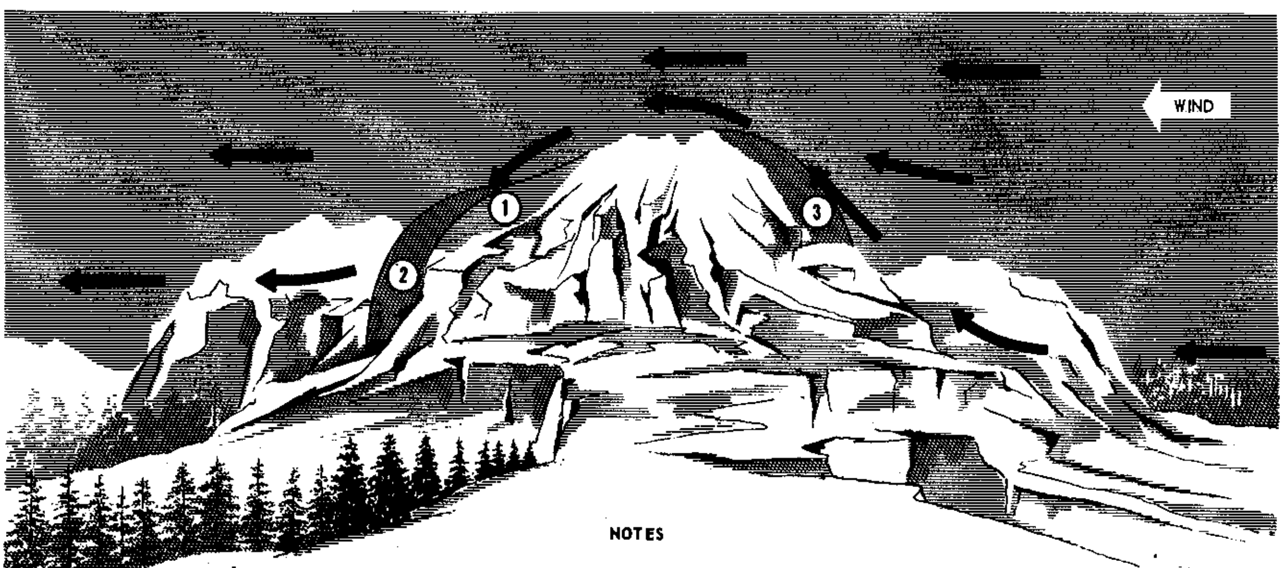


Figure 2-11. Wind Effect In A Confined Area

descent may be established of such magnitude that the helicopter will continue descending and crash, even though the helicopter is no longer affected by the downdraft. Therefore, the procedure for transiting a mountain pass shall be to fly close aboard that 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 is also a turn to lower terrain. The often used procedure of flying through the middle of a pass to avoid mountains invites disaster. This is frequently the area of greatest turbulence (figure 2-13) and in case of emergency, the pilot has little or no opportunity to turn back due to insufficient turning space. Rising air currents created by surface heating causes convective turbulence. This is most prevalent over bare areas. Convective turbulence is normally found at a relatively low height above the terrain, generally below 2000 feet. It may, however, under certain conditions, and in certain areas, reach as high as 8000 feet



NOTES

1. NULL AREA USUALLY FOUND ON LEEWARD SIDE AT CREST OF SLOPE.
2. IN VERY STRONG WIND CONDITIONS, AND/OR ON VERY STEEP SLOPES, TURBULENCE WILL BE FOUND ON THE LEEWARD SIDE OF THE SLOPE IN CLEAR AIR.
3. UP-DRAFTS WILL EXTEND ABOVE THE SURFACE FURTHER THAN THE TURBULENCE, DEPENDING ON WIND SPEED.

Figure 2-12. Wind Flow Over and Around Peaks

Figure 2-13. Wind Flow In Valley Or Canyon

above the terrain. Attempting to fly over convective turbulence should be carefully considered, depending on the mission assigned. The best method is to fly at the lowest altitude consistent with safety. Attempt to keep your flight path over areas covered with vegetation. 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.

ADVERSE WEATHER CONDITIONS.

When flying in and around mountainous terrain under adverse weather conditions, it should be remembered that the possibility of inadvertent entry into clouds is ever present. Air currents are unpredictable and may cause cloud formations to shift rapidly. Since depth perception is poor with relation to distance from cloud formation and to cloud movement, low hanging clouds and scud should be given a wide berth at all times. In addition to being well-briefed, the pilot should carefully study the route to be flown. A careful check of the helicopter compass should be maintained in order to fly a true heading, if the occasion demands.

SUMMARY.

The following guide lines are considered to be most important for mountain and rough terrain flying.

a. Make a continuous check of wind direction and estimated velocity.

Figure 2-14. Wind Flow Over Gorge Or Canyon

b. Plan your approach so that an abort can be made downhill and/or into the wind without climbing.

c. If wind is relatively calm, try to select a hill or knoll for landing so as to take full advantage of any possible wind effect.

d. When evaluating a landing site, execute as many fly-bys as necessary with at least one high and one low pass before conducting operations into a strange landing area.

e. Evaluate the obstacles in the landing site and consider possible null areas and routes of departure (figure 2-11).

f. Landing site selection should not be based solely on convenience, but consideration should be given to all relevant factors.

g. Determine power available and power required prior to attempting a landing.

h. Watch for rpm surges during turbulent conditions. Strong updrafts will cause rpm to increase, whereas downdrafts will cause rpm to decrease.

i. Avoid flight in or near thunderstorms.

j. Give all cloud formations a wide berth.

k. Fly as smoothly as possible and avoid steep turns.

l. Cross mountain peaks and ridges high enough to stay out of downdrafts on the leeside of the crest.

m. Avoid downdrafts prevalent on leeward slopes.

n. Plan your flight to take advantage of the updrafts on the windward slopes.

o. Whenever possible, approaches to ridges should be along the ridge rather than perpendicular.

p. Avoid high rates of descent when approaching landing sites.

q. Know your route and brief well for flying in these areas.

SLOPE LANDINGS.

When hovering over a slope, the amount of ground effect is less than when hovering over level ground. The percentage of ground effect lost will vary with the degree of slope. Prior to landing on slopes, the parking brake should be applied and the nosewheel locked to prevent the aircraft from rolling or turning. Ground contact should be made using a vertical descent. Sideward motion of the nose gear should be avoided to prevent breaking the nose gear lock.

Landings on slopes up to approximately 4 degrees differ very little from normal, level landings, and any direction of landing may be accomplished. On slopes greater than 4 degrees, a cross-slope landing with the right side up-slope is recommended whenever possible. The normal left-side low-hover attitude makes this type landing easier to accomplish than in other directions. If a right-side up-slope landing is not possible, the following order of preference in landing is recommended: Nose up-slope, left side up-slope, and nose down-slope. Nose-down, slope landings should be avoided due to danger of ground contact by the tailboom. Takeoffs and landings should be accomplished with smooth positive control movements to permit stopping or aborting the maneuver at any time. The helicopter will have a tendency to slide down-slope slightly during landings; however, rapid or excessive control movement should not be used to eliminate this characteristic. Proper cyclic trim position for takeoff will be retained if the trim is not adjusted after landing.

WARNING

Avoid using a combination of excessive cyclic and low collective setting. During slope operations with the AFCS engaged, cyclic control inputs will be induced by the AFCS due to fuselage attitude changes. These inputs will be in a direction to hold the helicopter on the slope but will reduce rotor-to-fuselage and rotor-to-ground clearance. If a large cyclic control movement or rapid reduction of collective is applied, excessive rotor blade flapping may occur. If the cyclic control is near the fore or aft position and the collective is lowered rapidly, the rotor blades may flex or dip sufficiently for the blades to contact the aircraft.

Cross Slope.

After the up-slope gear is on the ground, use smooth control inputs to maintain a near-level attitude. Reduce collective to place the nose gear on the ground and further reduce collective to lower the down-slope gear to the ground. As the collective is reduced, additional lateral cyclic control may be used to help control the rate of roll; however, avoid overcontrolling that could result in rotor blade contact with obstructions on the up-slope side of the aircraft. After the helicopter is firmly on the ground, decrease the collective to full down.

To take off from a cross-slope, slowly increase collective to bring the helicopter to a level attitude before breaking clear of the ground. The helicopter will normally roll towards the down-slope side just as the last gear breaks ground, and a large up-slope lateral cyclic input should not be used to avoid reducing rotor-to-ground clearance on the up-slope side.

Nose Up-Slope.

Use a normal vertical rate of descent until the nose gear contacts the ground. As the nose gear touches, slow the rate of descent slightly and use a small (approximately one inch) forward cyclic input to hold the nose gear firmly on the ground as the strut compresses. Then lower the main gear at normal rate of descent by reducing collective to the full down position. When the slope is near the limit of 8 degrees, there will be more of a tendency for the helicopter to roll down hill as the main gear descends; however, the roll is normally negligible. Use extreme care in applying additional forward cyclic, as it could result in rotor-blade-to-fuselage contact as the collective is lowered. After the initial forward cyclic input to get the nose gear firmly on the ground, only very small inputs (1/8 to 1/4 inch) are required to stabilize the pitch and roll attitude.

Takeoff is accomplished by increasing collective to establish a level attitude as the nose gear breaks clear of the ground. The cyclic control is used only to stabilize the attitude and not to lift the main gear off the ground.

Nose Down Slope.

The aft ramp may be opened enough to permit a crewmember to observe and report tailboom and rotor clearance. However, if the ramp is opened to the level position, its ground clearance will also be critical at near-maximum slopes or on uneven terrain. While descending vertically and as the main gear touches down, hold the cyclic stick essentially fixed, using only small stabilizing inputs, to prevent rotating the tail into the ground. The collective is then decreased to lower the nose gear to the ground. There is very little tendency for the helicopter to slide or to roll if brakes are applied prior to landing.

Takeoff is accomplished by increasing collective to establish a level attitude. As the main gear breaks ground, there is a tendency for the helicopter to move forward. Extreme caution must be used if this movement must be stopped, since any aft cyclic input may rotate the tail into the ground. If possible, it is best to let the helicopter move forward with little or no aft cyclic input until well clear of the ground. If this is not possible, a crisp and positive vertical rate of climb should be used from just before main gear lift-off until well clear of the ground.

SHIPBOARD OPERATING TECHNIQUES.

Helicopter Deck Handling.

Due to the topheavy configuration of the helicopter, precautions must be observed in all movements to preclude possibility of damage to the relatively light structural members and rotor blades. Chains and tiedowns should be installed at all times.

ROTOR ENGAGEMENT.

When the helicopter is ready in all respects and upon signal from primary flight control (PRI-FLY), the rotors may be engaged. Mandatory requirements for engagement of the rotor consist of the following items:

1. Main landing gear tiedowns secured with 2 to 3 inches slack and chocks in place.
2. Flight deck clear of unnecessary personnel.
3. Parking brakes on.
4. Winds below maximum wind velocities for rotor engagement.

CAUTION

With the rotors engaged on the flight deck, disengage the automatic flight control system. This is extremely important, especially when the ship is turning, as the turn will be resisted by the yaw channel and cause the helicopter to turn in relation to the deck of the ship.

SHIPBOARD LANDING.

(Refer to figure 2-15.)

When approaching a ship for landing or hover rescue operations, caution must be exercised to avoid the ship's superstructure, antennas, and cargo masts. Various ships, ship loads, winds, sea conditions, and ship's heading will cause a different pitch and roll cycle that must be evaluated prior to approaching the ship. For shipboard landing to port a left hand pattern should be flown at 300 feet and 70 knots. For landing to starboard a right-hand pattern should be flown. Prior to landing a before landing check should be performed and parking brakes should be set ON. The helicopter should be brought to a hover or near hover (not to exceed 5 knots in relation to the ship) short of and higher than the flight deck at the top of its pitch. Once the helicopter is on the deck, collective should be maintained in a full down position, and the AFCS disengaged. The tiedowns, chocks, and gear pins should be installed prior to accomplishing the after landing checklist.

SHIPBOARD TAKEOFF.

(Refer to figure 2-16.)

With the tiedowns removed, the chocks in place, and the parking brakes set, the helicopter should take off vertically and clear the ship. Landing gear should be raised as soon as the helicopter is clear of the ship.

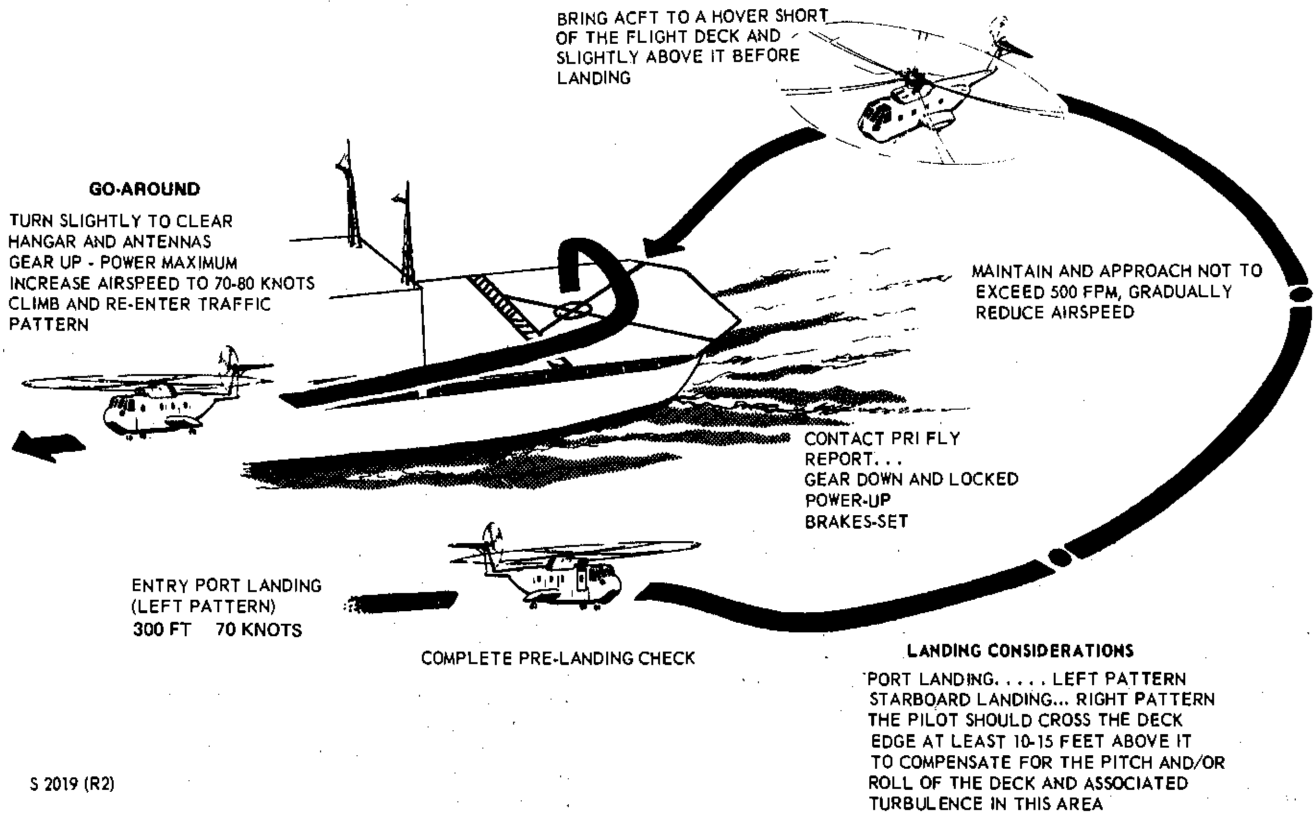


Figure 2-15. Typical Shipboard Landing and Go-Around

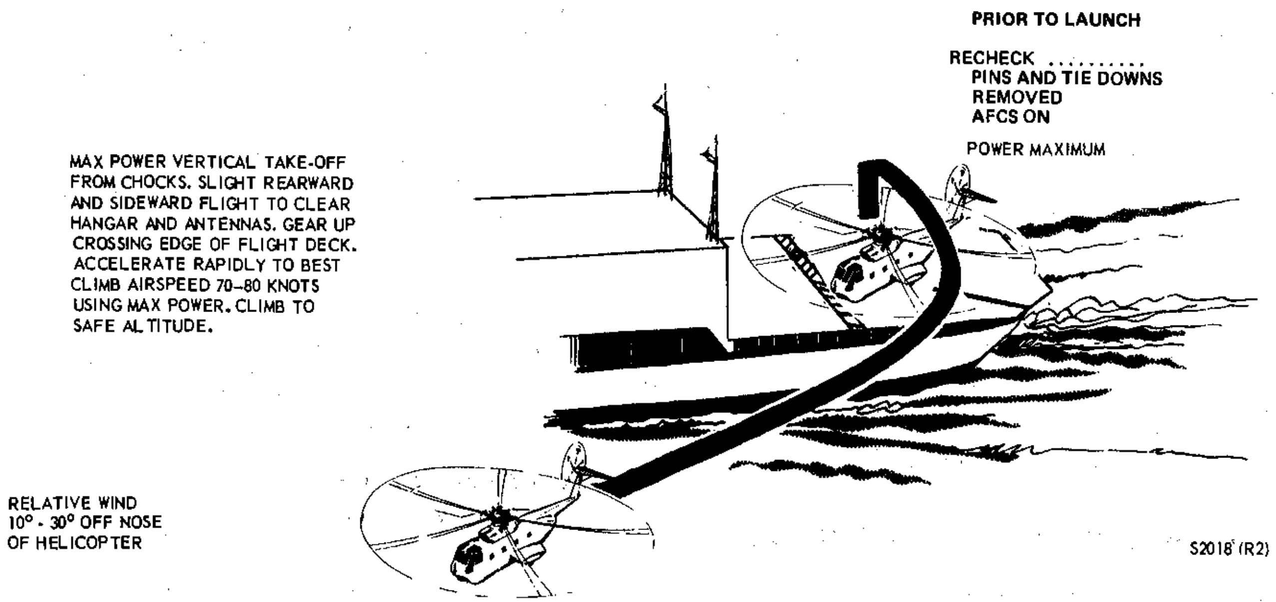


Figure 2-16. Typical Shipboard Takeoff

GO-AROUND.

Attain a minimum forward speed of 70 knots and establish a climb. Above 100 feet altitude, complete the AFTER TAKEOFF checklist.

AFTER LANDING.

The after landing check provides for reducing various electrical and other loads. After landing, if no portion of the AFTER LANDING checklist is accomplished and no change is made in the aircraft configuration from that prior to landing, or the ROTOR SHUTDOWN AND ENGAGEMENT (ENGINES RUNNING) checklist is used, use of the BEFORE TAKEOFF checklist is not required for the subsequent takeoff. For all practical purposes, the helicopter is still being controlled aerodynamically until the rotor is shutdown. The only action required on these short duration stops or landings is to maintain appropriate rotor speed and continuously monitor engine instruments.

1. Speed selectors - 102% N_r. (CP)
2. Lights - SET (CP)
3. Heater switch - OFF. (CP)

NOTE

The vent fan will continue to operate after the heater is shut off. Allow two minutes after the heater is shut off to allow the temperature in the plenum chamber to drop to 49°C (120°F) prior to removal of required electrical power sources. After shutdown, the temperature may rise due to residual heat, causing the fan to come on, especially if the free air temperature is very high.

4. Pitot heater switch - OFF. (CP)
5. IFF - AS REQUIRED (CP)

NOTE

Turn the IFF to STBY or OFF to eliminate signals which may block the controllers scope and interfere with the control of airborne aircraft.

6. "After Landing checklist completed." (CP)

ENGINE SHUTDOWN.

WARNING

When engine shutdown is to be accomplished with the APU inoperative, pull the No. 1 engine speed selector back to ground idle with the No. 2 engine driving the rotor at 100% N_r or above. If the generator caution lights illuminate, proceed with the Shutdown with Tail Takeoff Free Wheel Unit Inoperative checklist in Section III. If the generator caution lights do not illuminate proceed with the Engine Shutdown checklist.

NOTE

During engine shutdown, a designated crewmember or ground personnel should be positioned in front of the helicopter to monitor engine shutdown, droop stop positioning, and to preclude personnel from inadvertently trespassing into danger area. (See figure 2-2.)

1. Parking brake - "ON." (P)
2. AFCS - "OFF." (P)
3. Navigation sets, unnecessary radios, and doppler - "OFF." (CP)

NOTE

Doppler navigation equipment should be turned off prior to rotor shutdown as damage to the doppler power supply may result.

4. APU - "START." (CP or P)

   This will insure utility hydraulic pressure until the landing gear lock pins have been installed.

WARNING

If the APU is not running, pins and chocks will be inserted prior to rotor shutdown.

5. Engine and windshield anti-ice - "OFF." (CP)
6. Ignition switches - "OFF." (CP)
7. Speed selectors - "GRD IDLE.' (CP)

NOTE

To provide engine cooling prior to engine shutdown, one of the following conditions must transpire before moving the speed selectors to the SHUT-OFF position. However, in an emergency, the engine may be shut down immediately.

a. One minute of taxiing.

b. One minute of operation at, or above, the minimum governing range and with minimum collective pitch.

c. One minute at ground idle.

8. Droop stops - "IN." (FM)

CAUTION

One or more droop stops may not position properly during rotor shutdown. To preclude rotor blades from striking the tail pylon, neutralize flight controls and apply rotor brake as soon as practical.

9. Speed selectors - "SHUT-OFF." (CP)

10. Fuel management system - "OFF." (CP)

a. Fuel shut-off valve and crossfeed valve switches - CLOSE.

b. Fuel boost pump switches - OFF.

11. Rotor brake - "ON." (P)

Apply smoothly when rotor speed drops below 45%. Whenever the rotor brake hydraulic pressure is 10 PSI, and electrical power is supplied to the essential bus, the caution light will go on. When the rotor brake hydraulic pressure drops below 10 PSI, the light will go out.

NOTE

To reduce wear and to provide a smooth rotor shutdown, it is recommended to use 30% shutdown speed, wind permitting.

12. Electronic altimeter - "OFF." (CP, P)

13. T_5 - "CHECKED" (for possible post shutdown fire). (P or CP)

NOTE

A slow build-up of T_5 to temperature above 200°C after engine coastdown cooling is not abnormal, especially in warm weather. However, if T_5 reaches 260°C, monitor closely for possible post shutdown fire. If T_5 reaches 300°C, engage the starter with ignition off and motor the engine until T_5 is below 200°C.

CAUTION

If high T_5 persists, monitor fire warning lights and have engine exhaust stack visually checked for fire. If fire is detected proceed with ENGINE COMPARTMENT FIRE procedures in section III.

14. Pins and chocks - "IN." (FM)

WARNING

The auxiliary fuel tank pins will be installed prior to installing the wheel chocks and the wheel chocks will be installed prior to installing the landing gear lock pins and AN/ALE-20 safety pins.

15. APU - "OFF." (CP or P)

CAUTION

Permit the APU to coast down to 10% or below prior to turning the battery switch off or fire warning system will be inoperative.

NOTE

The fire warning system may activate momentarily on shutdown of engines or APU.

16. All radios - "OFF." (CP or P)

17. All electrical switches - "OFF." (CP or P)

18. Emergency exit lights switch - "RESET." (CP or P)

19. "Engine Shutdown checklist completed." (CP)

BEFORE LEAVING THE HELICOPTER.

The pilot will ensure that classified IFF codes (if used) have been removed and all required entries have been completed in the Form 781.

NOTE

The flight crew shall make entries in the Form 781 indicating when any flight limits have been exceeded.

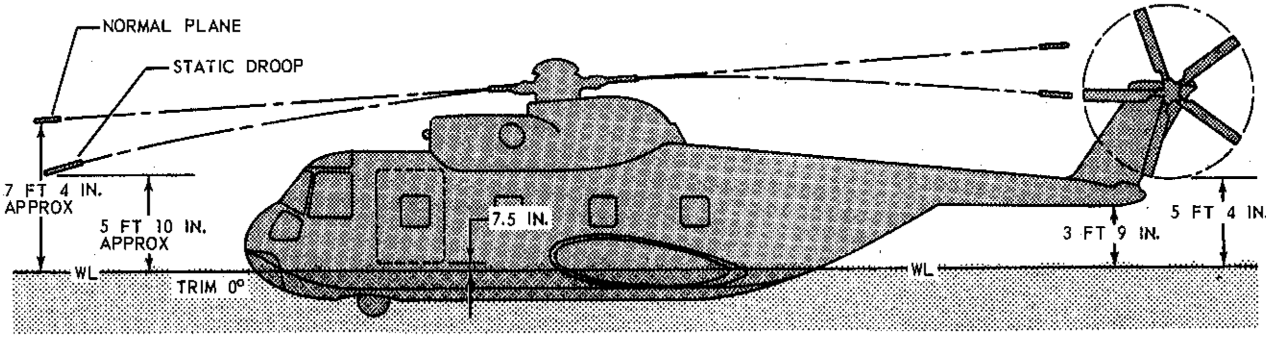


Figure 2-17. Water Clearance

ROTOR SHUTDOWN AND ENGAGEMENT (ENGINES RUNNING).

This checklist may be used for rotor shutdown and engagement (engines running) during operational stops and for water operations.

AFTER LANDING.

1. Speed selectors - 102%. (CP)
2. APU - START. (CP)

CAUTION

Failure to start the APU prior to rotor shutdown, with engines running, can result in lack of lubrication for the high speed engine drive shaft when rotors are reengaged.

3. Doppler/IFF - "STBY." (CP)

ROTOR SHUTDOWN.

1. Parking brake - "AS REQUIRED." (P)
2. AFCS - "OFF" (P)
3. Speed selectors - "GRD IDLE." (CP)
4. Droop stops - "IN." (FM)
5. Rotor brake - "ON." (P) (45% N_r OR LESS)
6. "Rotor Shutdown checklist completed." (CP)

ROTOR ENGAGEMENT AND BEFORE TAKEOFF.

1. Passenger and crew briefing - "COMPLETED." (P)
2. Ramp - "AS REQUIRED, CABLES ATTACHED." (FM)
3. Area - "CLEAR." (ALL)
4. Rotors - "ENGAGED." (P)
5. APU master switch - "OFF." (P)
6. Unloaded engine speed selector - "SET, 102%." (P)
7. Doppler/IFF - "AS REQUIRED." (CP)
8. Personnel door emergency release handle - "CHECKED." (FM)
9. Engine and transmission instruments - "CHECKED." (CP)
10. Caution and advisory lights - "CHECKED." (P)
11. AFCS - "CHECKED ON." (P)
12. Nose wheel - "UNLOCKED." (P)
13. Parking brake - "OFF." (P)
14. Passenger and crew - "READY FOR TAKE-OFF." (FM)
15. Radio call - "AS REQUIRED." (P or CP)
16. Speed selectors - "AS REQUIRED." (State Setting) (CP)
17. "Rotor engagement and Before Takeoff checklist completed." (CP)

WATER OPERATIONS.

The procedures in this section cover normal water operations as they differ from land operations. The helicopter is designed for amphibious operations which require an understanding of its capabilities in terms of sea state conditions. Refer to Figure 2-17, Water Clearance, to note the helicopter clearances when resting on the water. For normal operations with rotors turning, the helicopter may be operated in water up to and including sea state 3 as noted in Figure 2-20. Normal rotor shutdown and engagements may be conducted on water up to and including sea state 2 conditions.

Normally, aircrews operating in the vicinity of larger bodies of water or near coastlines will have information concerning sea state conditions either from the weather forecaster or from local Coast Guard units. It is imperative that pilots operating over open water become proficient in relating forecast and observed sea state conditions as seen from the air with actual conditions on the water. Figure 2-20 is provided to assist the pilot for this purpose. It should be noted that, depending on the duration that a given wind condition has existed, and the rate at which it has increased or decreased, the wave crest height and distance between crests will vary. The values shown in the table are for relatively steady state conditions of long duration. Further, the presence of ground swells makes accurate observations exceedingly difficult and requires good judgment to determine the effects of superimposing a wave system on the ground swells. When operating on the water, the pilot should be aware of several factors which will assist in determining the type and amount of control necessary. The hull and sponson design, coupled with considerable excess buoyancy, provide the helicopter with excellent roll stability characteristics. At lower sea states, this stability permits rotor shutdown with comparative ease. After rotor shut down, the helicopter will weathervane into the wind which reduces the possibility of larger roll angles being induced by the waves. When operating on the water with rotors turning, it may be necessary to use the flight controls to increase water stability. This may require use of cyclic to maintain a fairly level tip path plane as the helicopter pitches or rolls with the waves, or the use of collective to lighten the aircraft on the water and to increase rotor tip clearance and tail clearance. Usually a combination of these techniques are used, with the objective of maintaining a nominally level helicopter attitude to fully assure that neither the main nor tail rotor contacts the water.

WARNING

During water operations, airframe, rotor blade, and engine icing may occur when the temperature is at or below 5°C (41°F) OAT. Below -15°C (+5°F) the rate of accumulation will normally decrease. Icing may degrade performance to the point where flight becomes impossible, and visibility will be impaired with windscreen icing. The foreign object deflector will be installed if icing conditions are anticipated.

BEFORE STARTING ENGINES ON WATER.

Procedures are the same as in land operations; however, care must be exercised to insure the helicopter does not drift into obstacles or shallow water. If the rotor brake is not on, the helicopter will rotate to the right upon engine start.

ENGINE STARTING PROCEDURES ON WATER.

Procedures are the same as in land operations.

CAUTION

If APU is not used, generators must be turned off until the rotor accelerates to 96% N_r as underfrequency protection is not available.

ROTOR ENGAGEMENT ON WATER.

Procedures are the same as in land operations, except that the rotor brake is released prior to advancing either speed selector from GRD IDLE, and the speed selectors are advanced slowly to minimize rotation of the helicopter. As the rotor begins to accelerate, the helicopter will begin to turn to the right. To counter this rotation, full left tail rotor pedal should be applied prior to releasing the rotor brake. At approximately 30% rotor speed, the tail rotor pedal control is sufficient to stop the turn.

WARNING

Before rotor engagement, check that personnel, boats, and other obstructions are clear of the rotor blades.

BEFORE TAXIING ON WATER.

Procedures are the same as in land operations.

TAXIING ON THE WATER

All water operations should be accomplished at 100% N_r or higher to provide optimum water controllability and maximum rotor blade tip clearance above the water. Operation below 96% N_r on the water may result in electrical system damage caused by the lack of generator underfrequency protection. Water taxiing is relatively easy to perform when the water is calm, but becomes more difficult in swells or rough water. Water taxiing at normal speeds is accomplished by application of forward cyclic stick and sufficient collective to maintain the desired water speed. Lateral cyclic stick movements are used to control the rolling tendencies of the helicopter. The degree of cyclic control necessary to control the rolling tendencies becomes greater as the helicopter becomes lighter on the waves. The forward motion of the helicopter is stopped by aft cyclic stick and slightly raised collective pitch lever. Smooth taxi turns can be made by applying tail rotor pedals and cyclic stick into the direction of the turn. If turns are attempted by use of pedals only, the high vertical center of mass of the helicopter, combined with centrifugal force, will cause the helicopter to roll to the outside of the turn.

Taxiing maneuvers in rough water conditions require that the helicopter be kept in the water. Maximum tail rotor and main rotor blade clearances should be maintained by careful use of the collective and cyclic controls.

WARNING

Fast turns accomplished with tail rotor pedals only, and without cyclic stick held into the turn, may result in excessive roll angles and possible upset in rough water.

Water taxiing should be limited to approximately 15 knots. As water speed is increased above 10 knots, water will begin to build up over the bottom edge of the Plexiglas windows at the cockpit floor and may splash up to the bottom of the windshield. The nose of the helicopter may tend to pitch downward due to resistance of the water on the hull, a condition which the pilot should not allow to become excessive. To commence a taxi, twin engine power of 45 to 55% torque, or single engine topping power, should be achieved prior to placing the cyclic forward. Windshield wipers should be turned on as required. The helicopter tip-path plane must be monitored to prevent the rotor blades from striking the waves in rough water. Use of high power allows the helicopter to get as light as possible on the water and rapidly achieve maximum speed. Once desired speed has been reached, additional forward cyclic will only cause the nose to pitch down further. If this condition is reached, the taxi run should be aborted by smoothly lowering the collective. Water momentarily may spray up as high as the windshield as the collective is smoothly lowered, but the helicopter recovers to its normal attitude on the water quite readily. The position of the cyclic should be kept at neutral as the high speed taxi maneuver is aborted.

Lateral and Rearward Water Taxiing.

Sideward taxiing is limited because of the large flat plate area offered by the hull and sponsons. The large water resistance encountered by the hull and sponsons, and the relatively high helicopter center of roll, tend to make the fuselage roll in the direction of motion. Lateral taxiing has no real utility value in normal operations and should be avoided. Rearward taxiing may be accomplished but should be kept to a minimum.

Rearward taxiing is accomplished by raising the collective pitch and holding the cyclic aft, but not to the extent that it causes the blades to strike the droop stops. Rearward taxiing reduces the clearance of the tail rotor blades to the water, particularly in rough seas, and is not a recommended maneuver.

BEFORE TAKE-OFF ON WATER.

Same as land operations.

TAKE-OFF FROM THE WATER.

A normal vertical take-off from water is essentially the same as from land. There may be a tendency to drift in a hover, and a glassy sea state may cause altitude to be misjudged. It is recommended that extreme nose low take-off attitudes be avoided and the electronic altimeter be used for altitude judgment. Lifting to a hover from the water is the same as from a hard surface. As the helicopter is raised to the hovering altitude, rotor downwash will cause water spray to cover the windshield, but use of the windshield wipers will improve visibility. If prolonged hovering is to be performed over salt water, 30 to 40 feet of altitude should be maintained to reduce the amount of salt water ingestion into the engines.

RUNNING TAKE-OFF FROM WATER.

Normally a running take-off from water would be made directly into the wind. If the waves are greater than one or two feet, align the helicopter 30 degrees to either side of the waves and monitor tip-path plane for water clearance when applying forward cyclic stick. With speed selectors full forward, increase collective pitch slowly to attain a water taxi speed of no more than 15 knots. Control the helicopter's attitude with the cyclic stick to prevent any tendency of the nose to dig in. Increase collective pitch to obtain maximum power available. The copilot should be alert to operate the windshield wipers when required. Once the helicopter breaks water, altitude retention will be critical until climbing speed is reached. Attitude must be held constant by slowly and smoothly adding forward cyclic stick until airspeed builds up to approximately 40 to 50 knots, and then a climb can be initiated. When operating at a high gross weight, the helicopter may skim over the water for a few seconds before climbing speed is attained. The pilot should not pull back on the cyclic stick prematurely to establish a climb as the helicopter may settle back into the water. If the helicopter should settle into the water, the nose should be held up very slightly and the landing cushioned with power. If the helicopter has attained sufficient forward speed, it can occasionally be ballooned off the water by smoothly easing the cyclic stick back with a pumping action. However, forward cyclic stick should be carefully applied to allow the helicopter to gain airspeed.

AFTER TAKE-OFF FROM WATER.

Procedures are the same as in land operations.

CRUISE.

Procedures are the same as in land operations.

BEFORE LANDING ON WATER.

Procedures are the same as in land operations except: The landing gear remains up, the forward rotating anti-collision light off, landing light off and stowed, and the searchlight off and stowed. The external fuel tanks may be jettisoned, before landing on the water to preclude overstressing the airframe.

CAUTION

Water landings with external fuel tanks installed may be made on operational missions (rescue, recovery, etc.) at the pilot's discretion. A vertical landing with minimum forward speed and rate of descent should be made to avoid exceeding structural limitations of the sponsons/tanks.

NOTE

- Conditions permitting, the personnel door should be open for all approaches to the water and for all water taxiing, takeoffs and landings. Interaction between the cargo door assembly and the airframe could cause difficulty in opening and virtually prevent jettisoning the cargo door if the helicopter should become inverted on the water.

- If a water landing is made with external tanks installed, an entry will be made in the Form 781 and the aircraft inspected.

LANDING ON WATER.

A water landing is usually softer than its land counterpart because of the large contact area presented by the helicopter hull and sponsons.

CAUTION

- In calm water, do not exceed 10 degree noseup attitude at the point of water entry to avoid tail pylon water contact; in sea state 1.0 or higher, do not exceed 7 degree nose-up attitude. Maximum water contact speed is 20 knots. Touch and go water landings are not permitted.

- The forward strobe light extends approximately five inches below the aircraft. After water landings have been completed, the forward strobe light must be drained using screw plug at bottom of light prior to use.

NOTE

On those helicopters equipped with air refueling, water landings should normally not be accomplished. If accomplished, the refueling probe, especially the MA-2 nozzle, should be inspected to insure that damage has not occurred, or the nozzle has not opened to permit water to enter the fuel system. To avoid contaminating fuel in the event of water leakage, do not extend or retract the probe after a water landing has been accomplished. Tank sumps and lines shall be drained following all water landings.

Approach to a Hover Over Water.

An approach to a hover over water differs from its land counterpart in that depth perception is more difficult because of the lack of objects on the horizon for reference. The approach should be planned to place the helicopter at the desired hovering altitude with zero ground speed. Nose high helicopter attitudes should be avoided when operating near the water. If the helicopter is to be landed in the water from a hover, a hovering altitude of approximately 15 feet should be established to allow the pilot to become accustomed to the build up of water spray caused by rotor downwash. Use of the windshield wipers will be required if prolonged hovering is to be done at this altitude or a landing is to be effected. The pilot should approach the water cautiously to allow the rotor downwash to ripple the water surface to aid in depth perception. A continuous reference to the electronic altimeter should be made.

Forward Speed Landings on Water From a Hover.

Landings should be accomplished by holding the helicopter in a level to a slightly tail low attitude and allowing it to settle smoothly on the water. As the helicopter enters the water, more forward cyclic is normally required as the tail tends to tuck slightly. Maintain collective pitch until the helicopter decelerates and levels. At this time, lower collective smoothly and position cyclic as required. Dropping the collective rapidly will cause a nose-up pitching motion which results in reduced tail rotor clearance.

WARNING

If the cargo sling is installed or if the landing gear cannot be retracted, as in the case of fixed or pinned down gear, water landings shall be accomplished from a hover with a minimum of relative water speed. This is necessary since the increased drag of the sling/landing gear will cause the helicopter to pitch or roll and may result in rotor blade contact with the water.

CAUTION

If the helicopter contacts the water in a nosedown attitude, caused by technique or striking of a wave, the nose will pitch down in proportion to the contact speed. If this occurs, proper corrective action is to lower slowly the collective pitch and hold the cyclic neutral or slightly aft. Raising collective pitch after the nose has dug in can cause the helicopter to pitch over and allow the blades to strike the water.

CAUTION

On helicopters modified for mid-air retrieval (MARS) operations, water landings will be accomplished with a minimum of forward and vertical speed.

Forward Speed Landings on Water With High Sink Rate.

Forward speed landings with high sink rate can be accomplished by maintaining a rate of descent of 300 to 500 fpm at speeds between 30 to 40 knots prior to slowing the helicopter for touchdown. The water contact will not be as light as that when higher power is used but will provide a good positive landing. Landing technique does not differ from landings made with high power settings, but the pilot should expect the helicopter to sink slightly lower into the water on touchdown and more water to splash on the cockpit windshield. Once the landing has been made, the collective should be lowered slowly and the cyclic should be held in the neutral position. Because of the forward tilt of the main rotor shaft, the helicopter will tend to taxi forward if the collective is full down and the cyclic held neutral. To prevent forward movement, it is necessary to hold the cyclic slightly aft of neutral with sufficient collective pitch to hold a steady position in the water.

CAUTION

When making water landings in unfamiliar areas, accomplish a touchdown with power and no relative water speed, since mud, rocks, or other objects could cause the helicopter to tip and may cause the rotor blades to contact the water before a recovery can be effected.

ANCHORING THE HELICOPTER.

To effectively anchor the helicopter, the anchor that is supplied with the helicopter must be deployed as shown in figure 2-18. The anchor line must be at least three to four times the depth of the water in normal conditions, and as much as six or seven times the depth in rough or windy conditions. This provides for an essentially horizontal pull from which it develops its holding power. Under extreme conditions, a ten to twenty pound weight may be attached to the anchor line with a shackle and allowed to slide about halfway down. The weight should also be attached to a tag line so that it may be retrieved. The weight on the line causes it to have more slack; however the force of a wave passing under the hull will be largely absorbed in taking up the slack in the line. The wave will usually have passed before the slack is taken up completely and a more vertical pull applied to the anchor. A line of 150 feet is supplied to attach the anchor to the anchor line shackled permanently to the tow ring. In most instances, the 150 foot line is fastened to the eye of the anchor line with the attached snap ring. The entire length is then paid out after the anchor is lowered to the bottom. It is essential that the configuration shown in figure 2-18 be maintained, since a low center-line attachment insures that the helicopter will align with the wind and waves to present minimum drag and resultant minimum strain on the anchor line.

CAUTION

In no case should the anchor line be shortened or the prescribed configuration altered by attaching the anchor line to any of the internal tie down rings in the cabin. The increased drag caused by the asymmetrical attachment, and the resultant position broadside to the wind and waves, can cause the anchor to drag or possibly could capsize the helicopter.

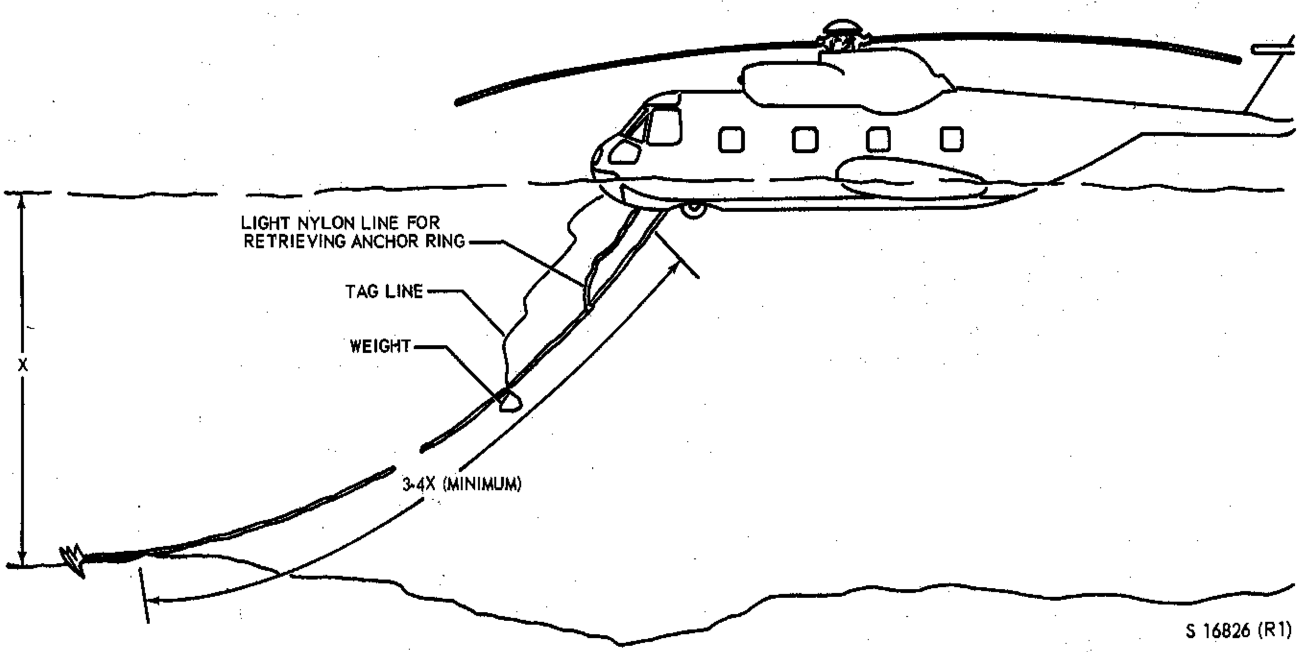


Figure 2-18. Anchoring The Helicopter

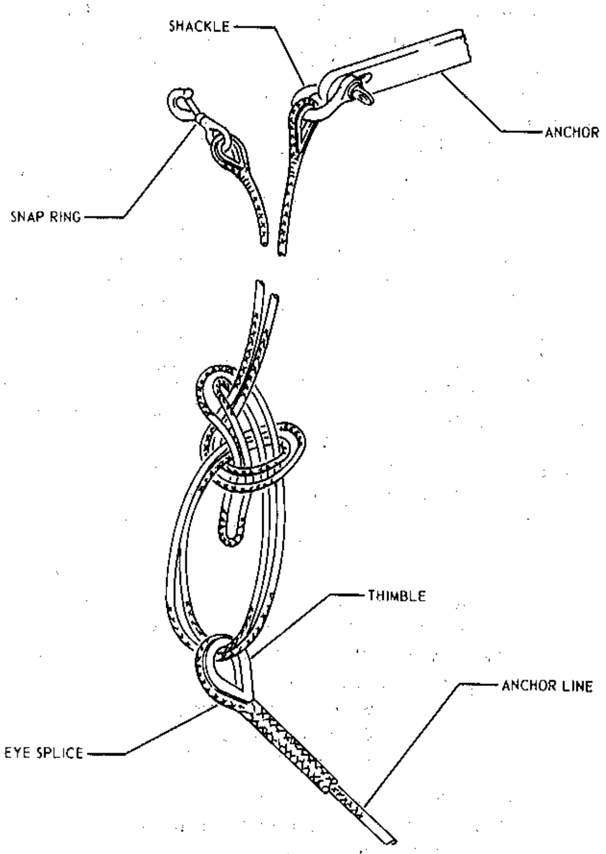


Figure 2-19. Method of Shortening The Anchor Line

If necessary to shorten the anchor line (primarily if deployment of the entire line in relatively shallow water would allow the helicopter to reach the shore or very shallow water) it may be done as shown in figure 2-19. Measure out the desired amount of the 150 foot line from the anchor end. Double it into a short loop at that point. Pass the short loop through the eye of the permanent anchor line and secure it with the knot shown (a bowline on bight). Then deploy the permanent anchor line as with the full 150 feet attached. In those instances where it is necessary to anchor in deeper water, additional line should be attached with the shackles or snap rings provided. The sea anchor should be deployed when the helicopter must remain on rough water more than 20 feet deep or on calm water more than 50 feet deep. A properly deployed sea anchor is effective in maintaining the helicopter heading into the on-coming swells.

The sea anchor, (figure 2-19a), if used, will be attached to the 150 foot anchor rope by the shackle to allow the snap ring on the other end of the rope to be connected to the helicopter mounted anchor rope as it was designed. Attach the sea anchor deployment line (red snap ring) to the crew entrance door forward hand grip by passing the red snap ring through the hand grip and attach it to its own deployment line.

After deployment assure that anchor line and retrieval line are free to allow the anchor to pull from the front center of the helicopter. If a regular sea anchor is not available, a parachute, an open litter bridled at the middle like a kite, or even a large plank, may be used to hold the helicopter into the wind and waves. This will minimize drift and rolling as much as possible.

Weighing Anchor.

Using the light nylon line provided, pull up the permanent anchor line to the cargo door then pull in the 150 foot line, drawing the helicopter into a position as close to vertical over the anchor as possible. The vertical lift thus applied should be sufficient to dislodge the anchor and allow it to be pulled into the helicopter.

NOTE

On helicopters equipped with an air refueling probe, the retracting line has been rerouted around the probe. This permits the anchor line to be lowered on the inside of the probe and retrieved on the outside of the probe. The anchor is then attached to the anchor line and lowered overboard. When retrieving, the anchor is guided to the outboard [illegible] of the probe by the retracting line. The anchor is then removed from the anchor line and stowed. The retracting line is then used to secure the anchor line and bungee cord until it can be rigged when the helicopter lands.

BEACHING.

CAUTION

It is recommended that the helicopter be flown from the water to the landing area and not beached by taxiing from water onto land to avoid damage to equipment on the hull of the helicopter.

DOCKING.

Docking helicopters requires extreme vigilance on the part of the pilot and docking crew. Because the helicopter can move in any direction, the fixed wing or boat techniques are not as important as far as water currents and winds are concerned. Adequate main rotor clearance between personnel and objects are of prime concern. Sufficient personnel should be available at all times to direct and assist in docking the helicopter. A docked helicopter should not be left unattended. The bilge pump shall be manned if the helicopter is to be docked for extended periods of time.

ROTOR SHUTDOWN ON WATER.

Use the AFTER LANDING and ENGINE SHUTDOWN checklists when the engines are to be shutdown.

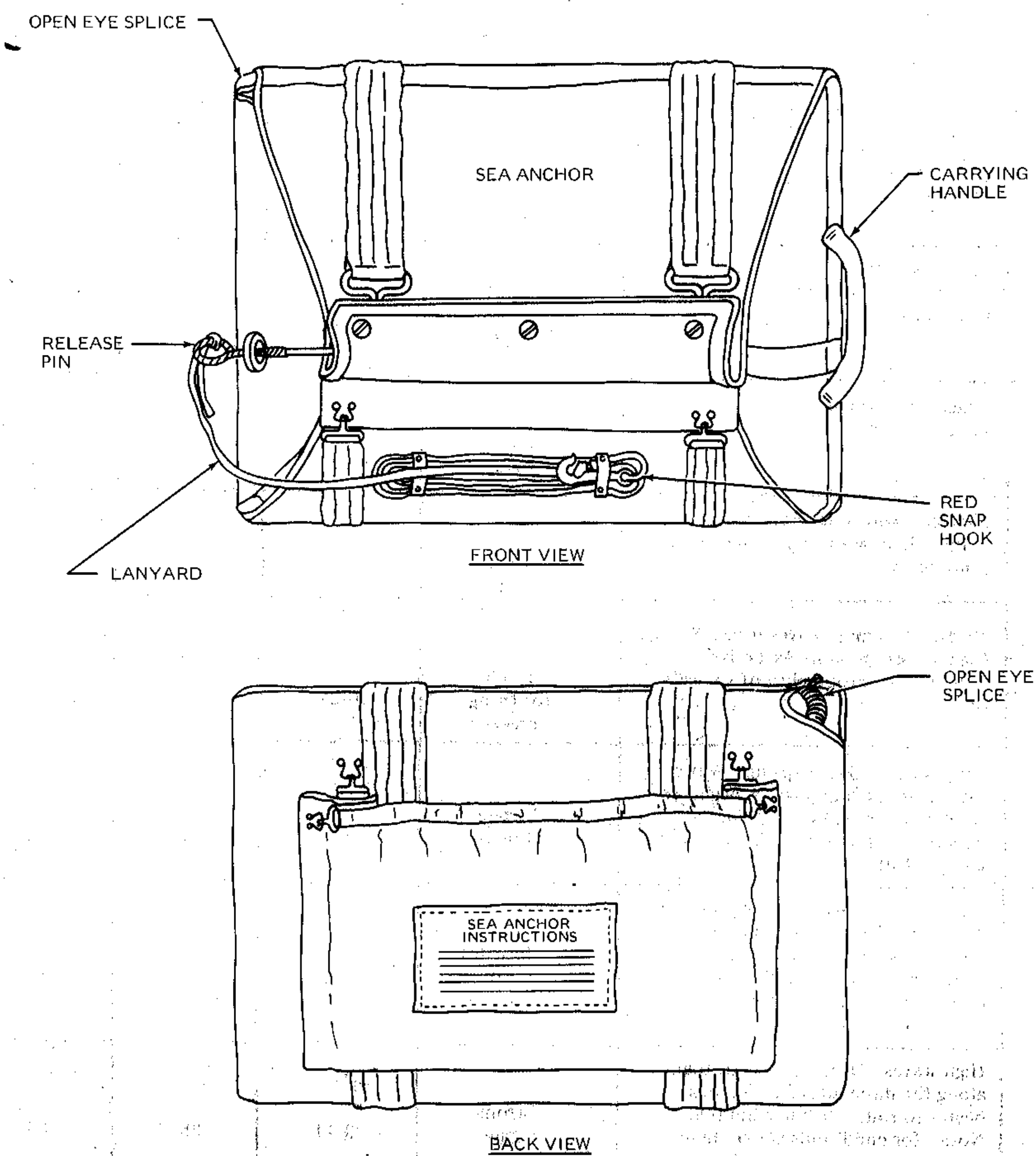


Figure 2-19A. Sea Anchor.

	SEA INDICATIONS	WIND		WAVES	
SEA STATE	DESCRIPTION	DESCRIPTION	VELOCITY RANGE (KNOTS)	WAVE HEIGHT IN FEET AVERAGE	WAVE HEIGHT IN FEET MAXIMUM
0	Sea may look like a mirror or small ripples with appearance of scales, but without foam crest.	Calm to light airs	0-3	0	Less than 6 inches
1	Wavelets that are short but pronounced. Crests may begin to break. Perhaps very few scattered whitecaps.	Light to gentle breeze	4-9	6 inches	1
2	Large wavelets or small waves, becoming larger. Fairly frequent whitecaps.	Gentle to moderate breeze	10-13	2	3
3	Small waves becoming larger. Frequent whitecaps.	Moderate breeze	14-16	3	5
4	Moderate waves, pronounced long foam. Many whitecaps. Change of some spray.	Fresh breeze	17-19	4.5	7
5	Moderate to large waves form. White foam crests are more extensive everywhere. Probability of some spray.	Fresh to strong breeze	20-24	8	12
6	Large waves. Sea heaps up. White foam from breaking waves begins to be blown in streaks along the direction of the wind. May begin to see spindrifts.	Strong breeze	25-28	11	18
7	Sea heaps up. Streaks along the direction of wind. Moderately high waves of greater length. Edges of crest break into spindrift. The foam is blown in well marked streaks along wind direction.	Moderate to fresh gale	29-38	25	40
8	High waves. Dense streaks of foam along the direction of wind. Sea begins to roll. Visibility limited. Note: for conditions above these limits, use Whole Gale, Storm, or Hurricane definition.	Strong gale	39-44	36	58

Figure 2-20. State of Sea

When the rotors are to be shutdown while the engines remain operating, use the ROTOR SHUTDOWN AND ENGAGEMENT (ENGINES RUNNING) checklist. Without the stability and control afforded by the rotating blades, the helicopter cannot right itself from a roll greater than approximately 13 degrees. Extending the landing gear will help somewhat by lowering the vertical CG. Wind and water conditions above sea state 2.0 or greater may cause excessive rolling and possible capsizing. After the rotors have stopped, the helicopter will normally align itself into the wind and waves. When engines are shutdown, apply rotor brake at 20% Nr. When engines are not shutdown, apply rotor brake at minimum obtainable N_r. If the rotor brake is used, the helicopter may rotate to the left as much as 360 degrees. Towing should be accomplished into the wind and at no greater water speed than 4 knots.

CAUTION

Failure to start the APU prior to rotor shutdown, with the engines running, can result in lack of lubrication for the high speed engine drive shaft when the rotors are reengaged.

CAUTION

If APU is not on, turn generators off before rotor speed is reduced below 96% N_r as underfrequency protection is not available.

TOWING OF HELICOPTER ON WATER.

The recommended attachment point for a tow line is the anchor fitting at the nose of the helicopter. Use approximately 100 feet of tow line to prevent surging up on the tow boat. Normally, a two to three inch manila rope will be used. If on salt water and time and sea conditions permit, using two ropes to each sponson, tie down fitting may prevent water from entering the nose compartment and damaging electronic equipment. If a regular tow rope is not available, the anchor line may be retrieved and used as a tow line. Whenever possible, towing should be accomplished into the wind. Maximum water speed for towing is 4 knots.

CAUTION

Avoid heading parallel to troughs of waves as this may cause excessive roll.

CAUTION

Use care to avoid damage to the helicopter when the tow boat is alongside. The tow boat should remain upwind when in close proximity to the helicopter because the helicopter will drift downwind more rapidly than the boat.

CAUTION

To prevent excessive rolling and possible upset, do not tow the helicopter in a rearward direction.

During towing operations, the sea anchor should be rigged out the aft ramp to assist in stabilizing the helicopter. The bilges must be checked periodically for water leakage. Some water in the bilges may provide additional stabilization in higher sea states.

CAUTION

Change directions gradually while towing.

AFTER LANDING ON WATER.

Procedures are the same as in land operations.

ENGINE SHUTDOWN ON WATER.

Procedures are the same as in land operations.

BEFORE LEAVING THE HELICOPTER ON WATER.

Procedures are the same as in land operation, except the bilge pump should be installed and a crew member should remain with the helicopter to man the bilge pump.

SALT WATER OPERATION.

ENGINE COMPRESSOR EFFICIENCY/PERFORMANCE

Operational experience has shown that salt spray ingestion in the T58 engine will result in reduced compressor efficiency/performance and subsequent decrease in compressor stall margin. This makes the engine susceptible to stalls during accelerations but more especially during deceleration. As the spray is ingested and contacts the compressor blades/vanes, salt is deposited. A gradual buildup results which changes the airfoil sections which in turn decreases the compressor efficiency/performance. This will be noticed by a decrease in torque (Q) and an increase in T_5 for a given N_g. Should compressor efficiency decrease to a point where the compressor actually stalls, T_5 will increase while N_g and torque will decrease. The circumstances, under which compressor stalls may occur during salt water operation, vary with a number of factors, i.e. flight regime, gross weight, wind direction/velocity, pilot technique, duration of maneuver, salinity of the water and relative density of the salt spray. Intermittent operation in moderate salt spray conditions (such as a series of landings and take-offs) can expose engines to enough salt spray to cause a noticeable change in torque and T_5 at a given N_g. This change is more apparent, and also more critical, during prolonged operations (such as hovering or taxiing) in heavier spray conditions. Maneuvers such as hovering close to the water in light winds (under about 8 knots), taxiing with high power or low flights at low speeds will generate maximum rotor downwash spray conditions. Careful operation, following the procedures and limitation contained herein, and strict adherence to the prescribed maintenance procedures when operating in these conditions will provide adequate compressor efficiency/performance to prevent stalls due to salt water ingestion.

NOTE

Following salt water operations, make appropriate entries in Form 781 reflecting operation on or over salt water.

HOVERING.

Hovering over salt water at altitudes which cause concentrated spray into the engine inlets results in gradual reduction of compressor efficiency and subsequent decrease/loss of stall margin. Operation in these conditions should be avoided or minimized. Use the altitude/time combinations in Figure 2-21 as a guide for planning salt water hover operations. The actual conditions encountered (weight, wind, etc.) and the techniques employed to minimize salt spray ingestion will combine to determine the actual hover altitude/time available. Salt spray ingestion is characterized by a noticeable and steady increase in T_5 for a given torque setting. Prior to salt water hovering accomplish the following on each engine:

1. Perform an N_g/T_5 relationship check.

2. Compare indicated T_5 to the established base line and note the difference.

3. Upon initially entering the hover, note the Ng, torque and T_5 values for each engine.

WARNING

The maximum allowable T_5 rise when hovering at a constant N_g and torque is 35°C minus the difference noted in step 2 above; i.e., if indicated T_5 in step 2 was less than, or did not exceed the baseline, a 35°C rise from the T_5 value noted in step 3 is permissible. If indicated T_5 was 10°C above the baseline, only 25°C T_5 from step 3 value is permissible.

WARNING

If salt spray ingestion during hover operations results in a limiting T_5 rise, leave the salt spray environment. Use extreme care to minimize engine acceleration and deceleration to avoid a compressor stall. If possible, use only one power application and one power reduction for return flight. Use the minimum power required for take-off, transition, and climb; do not reduce power enroute, and initiate power reduction at destination with sufficient altitude for an autorotative landing.

4. Using Figure 2-21 as a guide for hover altitude/expose time, check T_5 rise by stabilizing as near as possible to the same N_g and torque that was used in step 3 and leave the salt spray environment when limiting T_5 is reached.

NOTE

The FOD shield provides engine protection because the air entering the engine must make two turns of approximately 90°. These turns cause the heavier water particles to centrifuge from the air stream; therefore, use of the FOD shield is recommended for salt water operations.

Hover Altitude	Hover Time
40 Feet	120 Minutes
35 Feet	90 Minutes
30 Feet	60 Minutes
25 Feet	45 Minutes
20 Feet	30 Minutes
15 Feet	15 Minutes
10 Feet	5 Minutes
2-5 Feet	2 Minutes

NOTE

The hover altitude/time combinations are to be used as a guide in conjunction with the T_5 criteria for conducting normal hovering operations. In terms of salt accretion, this figure shows maximum exposure time. Intermittent partial exposure at multiple hover altitudes accumulate as proportions of full exposure, i.e. hovering 5 minutes at 15 feet plus 10 minutes at 20 feet plus 15 minutes at 25 feet would total a maximum or full exposure.

Figure 2-21. Altitude/Time Hovering Over Salt Water

For all hovering operations salt water ingestion may be minimized by adjusting the hover attitude for all wind conditions. Salt spray concentration can be expected under the following wind conditions.

No wind. Hovering in no-wind conditions normally will result in relatively low salt spray concentrations at all hovering altitudes.

Light wind (approximately 0-5 knots). Hovering in these conditions may result in the heaviest salt spray concentrations. Spray may be further minimized by hovering cross-wind at an altitude of approximately 10 to 15 feet.

Moderate to heavy winds. (10 knots and above). Higher winds normally will result in the lowest salt spray concentrations at all hovering altitudes. In these conditions hovering should be accomplished into the wind.

POST FLIGHT CHECK.

Following salt water operations, make appropriate entries in Form 781 reflecting operation on or over salt water and insure that applicable water wash/dry cycle/rustlick procedures are accomplished. Insure all equipment exposed to salt spray/water is washed with fresh water.

ALERT PROCEDURES.

COCKING PROCEDURES.

Prior to assuming alert, the helicopter will be run up to include completion of all checks through BEFORE TAKEOFF, systems checkout, and shutdown using the AFTER LANDING and ENGINE SHUTDOWN checklists, after which the helicopter may be cocked using the COCKING checklist. When a helicopter requires to be cocked following a flight, it is considered to have all required systems checked, and it may be cocked using the COCKING checklist provided the AFTER LANDING and ENGINE SHUTDOWN checklists were accomplished. The SCRAMBLE checklist will not be used unless the COCKING checklist has been accomplished.

Cocking Checklist.

1. Parking Brake - "RESET." (P)
2. Rotor Brake - "ON." (P)
3. Overhead Switch Panel — "SET." (P) (Battery Switch off)
4. Ignition Switches — "NORMAL." (CP)
5. Fuel Management System — "SET." (CP)
   a. Fuel Shut-off Valves — Open
   b. Boost Pumps — On
6. Electronic Altimeters — "ON." (CP) (P)
7. Navigation and Communications Radios — "SET." (CP) (P) (Doppler Set Off)
8. Cocking Checklist — "COMPLETED." (CP)

SECURITY OF COCKED HELICOPTER.

When the helicopter is cocked, no one will enter the helicopter except the aircrew members assigned to that helicopter for alert. All systems checked in conjunction with cocking the helicopter need not be repeated so long as the aircraft remains cocked. Placards, reading "Entry Prohibited - Helicopter Cocked", will be placed near the helicopter. If a maintenance requirement arises while the helicopter is cocked, the alert pilot will first uncock the helicopter, using the UNCOCKING CHECKLIST. The alert pilot, using the COCKING PROCEDURES, will accept the helicopter after maintenance is accomplished.

UNCOCKING CHECKLIST.

1. All electrical switches - OFF.

2. Ignition switches — OFF.
3. Fuel shut-off valves — CLOSED.
4. Boost pumps — OFF.
5. Electronic altimeters — OFF.
6. Navigation and communication radios — OFF.
7. Parking brake — AS REQUIRED.
8. Uncocking checklist — COMPLETED.

SCRAMBLE CHECKLIST.

1. External power switch — "OFF" (ON IF EXTERNAL POWER USED). (P)
2. Battery switch — "ON" (OFF IF EXTERNAL POWER USED). (P)
3. Protective covers, pitot covers, engine plugs, tie-downs and static wire — "REMOVED." (FM)
4. Safety belt and harness — "FASTENED." (P,CP)
5. Rotor brake — "LOCK — OFF, BRAKE-ON." (P)
6. Caution and advisory lights — "CHECKED." (P)
7. APU — "CLEAR." (FM), "STARTING." (CP or P)
8. Caution and advisory lights — "CHECKED." (P)
9. Transmission and hydraulic indicators — "CHECKED." (P)
10. Battery switch — "ON" (IF EXTERNAL POWER USED). (P)
11. External power switch "OFF" (IF USED) AND DISCONNECTED. (P)
12. No. 1 engine — "CLEAR." (FM) "STARTING." (CP or P)
13. No. 2 engine — "CLEAR" (FM) "STARTING" (CP or P)
14. Pins and chocks — "REMOVED." (FM)
15. Area — "CLEAR" (P, CP, FM)
16. Rotors — "ENGAGED." (P)
17. APU master switch — "OFF." (P)
18. Unloaded engine speed selector — "SET — 102%." (P)
19. Engine and windshield anti-ice — "AS REQUIRED." (CP)
20. Pitot Head — "AS REQUIRED." (CP)
21. Doppler — "STBY." (P, CP)
22. Lights — "SET." (P)
23. Radio call — "COMPLETED." (P, CP)
24. Cabin area — "SECURE." (FM)
25. Nose wheel — "UNLOCKED." (P)
26. Engine and transmission instruments — "CHECKED." (CP)
27. Flight instruments — "CHECKED." (P, CP)
28. AFCS — "ON AND INDICATORS CHECKED." (P, CP)
29. IFF and Doppler — "ON." (CP)
30. Parking brake — "OFF." (P)
31. Speed selectors — "AS REQUIRED." (CP)
32. "Scramble checklist — COMPLETED." (CP)

HOT REFUELING OPERATIONS.

The following procedures describe hot refueling operations with the rotors engaged and one engine operating. The flight engineer will refuel helicopter, insure that the pressure refueling system used is compatible with the helicopter fuel system, that the proper type fuel is used, and that the aircraft and single point nozzle are properly grounded. The aircraft commander is responsible for positioning the aircraft in the fueling area clear of all obstructions and will ensure that all procedures outlined herein are complied with.

NOTE

These procedures will be used only when authorized by the Major Command and a System Safety Engineering Analysis has been performed.

AFTER LANDING.

1. Speed selectors — "AS REQUIRED." (CP)
2. Fuel management system — "AS REQUIRED." (CP)
   a. Fuel cross-feed valve — CLOSE.
   b. Forward boost pump — ON.
   c. Aft boost pumps — OFF.

3. External auxiliary fuel tank pressurization switches - "OFF." (CP)

4. Doppler - "OFF." (CP or P)

5. Electronic altimeter - "OFF." (P)

6. IFF - "AS REQUIRED." (P)

NOTE

Turn the IFF to STBY or OFF to eliminate signals which may block the controllers scope and interfere with the control of airborne aircraft.

7. "After Landing checklist completed." (CP)

~~NO. 2 ENGINE SHUTDOWN.~~

NOTE

Shutdown No. 2 engine as soon as possible after landing and prior to taxiing to the refueling area. This allows maximum engine cooling and minimizes fire hazard during refueling operations.

1. No. 2 ignition switch - "OFF." (CP)
2. No. 2 speed selector - "GROUND IDLE." (CP)

NOTE

To provide engine cooling prior to engine shutdown, allow one minute at ground idle before moving the speed selector to the SHUT OFF position.

3. No. 2 speed selector - "SHUT OFF." (CP)
4. No. 2 fuel shut-off valve - "CLOSE." (CP)
5. "No. 2 Engine Shutdown checklist completed." (CP)

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REFUELING.

WARNING

- Do not operate aircraft radio equipment (UHF, VHF, HF or FM) while in the refueling area.
- Hot refueling is not authorized when ground refueling from C-130 aircraft.

1. Parking brake - "ON." (P)
2. Windows and doors - "AS REQUIRED." (ALL)

NOTE

The personnel door will remain open to permit rapid egress of the crew in the event of an emergency while refueling. All windows, hatches, and the ramp will be closed.

3. Refueling unit - "POSITIONED." (FM)
4. Ground static wires - "ATTACHED." (FM)
   a. Helicopter - GROUNDED.
   b. Refueling unit - GROUNDED.
   c. Helicopter to refueling unit - GROUNDED.
   d. Fuel nozzle to helicopter - GROUNDED.
5. Fire guard - "POSTED." (FM)
6. Protective cap - "REMOVED." (FM)
7. Refueling nozzle - "CONNECTED." (FM)
8. Refueling panel - "AS REQUIRED." (CP)
   a. Master power switch - ON.
   b. Main tank select switches - FWD and AFT.
   c. External tank select switches - LEFT and RIGHT.
9. Fuel flow - "ESTABLISHED." (CP, FM)
10. Preshut-off test - "COMPLETED." (CP)

NOTE

Refuel helicopter at a maximum flow rate of 150 gpm or 50 psig, measured at adapter. As fuel enters helicopter, MAIN TANKS FWD and AFT and EXT TANKS LEFT and RIGHT FLOW indicating lights will illuminate. Immediately following start of fuel flow, precheck internal tank high level control valves and external shutoff valves by pressing PRE SHUT-OFF TEST switch. When switch is pressed, fuel flow will stop and FLOW indicating lights will go out. When switch is released, fuel flow will resume and FLOW indicating lights will illuminate. When tanks are full, FWD and AFT FLOW lights will go out. EXT TANKS LEFT and RIGHT FULL lights will illuminate, and LEFT and RIGHT FLOW lights will go out.

CAUTION

Failure of flow lights to extinguish when preshutoff test is accomplished indicates a system malfunction and refueling should be terminated.

11. "Refueling checklist completed." (CP)

POST REFUELING.

1. Fuel flow - "STOPPED." (CP, FM)
2. Refueling panel - "AS REQUIRED." (CP)
   a. ~~Tank select switches - AS REQUIRED.~~
   b. Master power switch - OFF.
3. Refueling nozzle - "DISCONNECTED." (FM)
4. Protective cap - "INSTALLED." (FM)

5. ~~Ground static wires - "DISCONNECTED." (FM)~~

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6. ~~"Post Refueling checklist completed." (CP)~~

ENGINE RESTART.

1. Parking brake - "OFF." (P)

WARNING

Taxi clear of the refueling area prior to restarting No. 2 engine.

2. Fuel management system - "AS REQUIRED." (CP)

   a. No. 2 engine fuel shut-off switch - OPEN.

   b. Cross-feed valve switch - CLOSED.

   c. Aft boost pump switch - ON.

3. No. 2 ignition switch - "ON." (CP)

4. Fire guard - "POSTED." (FM)

5. No. 2 engine - "START." (CP)

6. No. 2 speed selector - "MATCH TORQUE." (CP)

7. Doppler - "STANDBY." (CP)

8. Electronic altimeter - "ON." (P, CP)

9. IFF - "STANDBY." (P)

10. "Engine Restart checklist completed." (CP)

Proceed with BEFORE TAKEOFF checklist.

FUEL DUMPING SYSTEMS PROCEDURES.

The fuel dumping systems consist of an internal auxiliary fuel tank dumping (jettison) system, that may be installed on CH-3E helicopters prior to 16. A manual fuel dumping system is provided for helicopters modified by T.O. 1H-3-505. A rapid fuel dumping system is provided for CH-3E 16 and all HH-3E helicopters. Fuel dumping may be accomplished to decrease the gross weight of the helicopter to permit continued single engine flight to an area where a safe landing may be accomplished, or if an emergency landing is necessary, to minimize the amount of fuel that will be aboard the helicopter on contact.

WARNING

Fuel off-loading operations should be conducted with the ramp closed, if installed, and the aircraft heater/vent fan off in order to preclude the possibility of fumes entering the aircraft. Smoking is also prohibited.

WARNING

Fuel dumping in an in-ground effect hover should be avoided because of possible aircraft or engine fire from recirculation of fuel vapor by rotor wash.

Internal Auxiliary Fuel Tank Dumping (Jettisoning) System.

Fuel may be dumped (jettisoned) at a rate of approximately 425 pounds per minute.

1. Auxiliary fuel jettison switch - JETTISON.

Manual Fuel Dumping System.

Fuel may be dumped from the main forward tank, when required, at a rate of approximately 150 pounds per minute.

CAUTION

The manual fuel dumping system will dump the entire fuel load from the forward tank if not monitored. The system uses the existing fuel boost pumps in the forward tank and does not provide the protection of 500 pounds reserve in each tank that the rapid fuel dumping system provides.

NOTE

When the manual fuel dump system valve is in operation, fuel booster pump failure lights and fuel filter bypass lights may illuminate. This is a normal condition caused by a drop in prime fuel pressure and the resultant pressure differential across the fuel filters. The fuel booster pump failure lights should go out when the fuel pressure stabilizes upon release of the manual fuel dump valve.

1. Crew - ALERTED.

2. Communication - MAKE APPROPRIATE RADIO CALLS. (Do not make radio calls during dumping to eliminate ignition source from radios, especially HF).
3. Heater/vent fan - OFF.
4. No smoking.
5. Aft ramp and cargo door - CLOSED.
6. All boosts pumps - ON.
7. Crossfeed valves - OPEN.

CAUTION

The No. 1 engine will flame out if crossfeed is not OPEN before the manual fuel close line valve is CLOSED.

8. Manual fuel close line valve - CLOSED.
9. Manual fuel dump line valve - OPEN.
10. Fuel quantity gauge - MONITOR.

To Stop Fuel Dump.

1. Manual fuel dump line valve - CLOSED.
2. Manual fuel close line valve - OPEN.
3. Crossfeed valve - AS REQUIRED.
4. Boost pump - AS REQUIRED.
5. Visually check that fuel dumping has stopped. Residual fuel may continue to flow for a short time after fuel dumping has been terminated.

CAUTION

The boost pumps in forward tank will be turned OFF as soon as the forward fuel quantity gage indicates empty to avoid a possible fire from an overheated fuel pump.

Rapid Fuel Dumping System.

Fuel may be dumped from both main tanks individually or simultaneously by activating the dump switches located on the pressure refueling panel. Dump rate is approximately 880 pounds per minute.

WARNING

Ensure that heater switch and AN/ALE-20 arming switch are off prior to dumping as fuel may be ignited.

CAUTION

Turn off dump switches before fuel quantity gages indicate 500 pounds to avoid overheating the fuel dump pump.

FLIGHT CREW CHECKLIST.

Your flight crew checklist is contained in T.O. 1H-3(C)C-1CL-1.

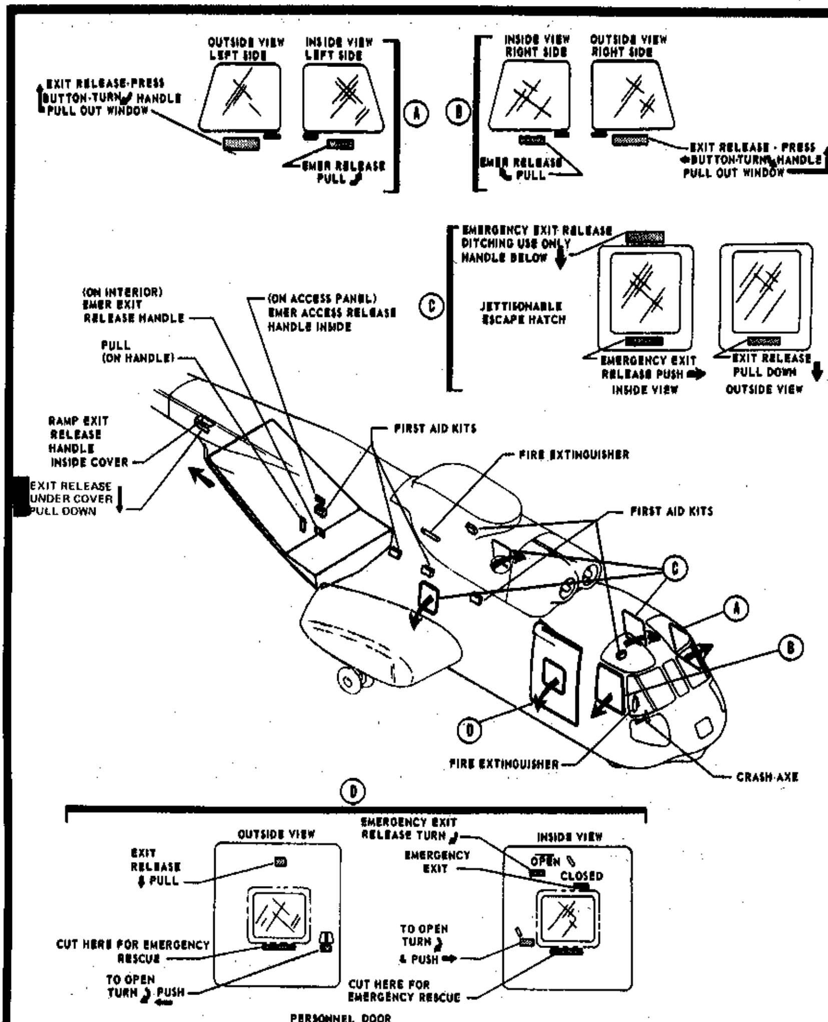
PASSENGER INFORMATION.

1. Smoking is prohibited during ground operation, take-offs, landings, aerial refueling and when directed by the helicopter commander.
2. Safety belts will be securely fastened for all take-offs, landings, aerial refueling and flight through turbulent air.
3. Operation of portable electronic equipment is prohibited. The use of butane and/or plastic reservoir type lighters is prohibited.
4. All passengers should wear ear protective devices to avoid ear damage.
5. If it becomes necessary to evacuate the helicopter, refer to diagram on reverse side for exits.
6. If a crash landing becomes necessary, proceed as follows:
   a. Jettison emergency exits as directed by the helicopter commander.
   b. Loosen tie.
   c. Fasten safety belt tight.

Just prior to contact with the surface, passengers will fold arms resting them on their knees. Bend body forward as far as possible and rest head firmly on arms. If available, hold pillow, blanket, or clothing in front of head to cushion possible impact.

7. Alarm bell.
   a. Bail Out: 3 short rings followed by one continuous ring.
   b. Crash Landing: 6 short rings followed by one continuous ring.

Figure 2-22. Passenger Information



EMERGENCY EXITS AND EQUIPMENT

Figure 2-23. Emergency Exits and Equipment