SECTION III

EMERGENCY PROCEDURES

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IMMEDIATE ACTION ITEMS.

This section contains the procedures to be followed to correct an emergency condition that could reasonably be encountered. Multiple emergencies, adverse weather, or other unusual conditions may require modification of these procedures. Emergency procedures are divided into critical and noncritical items. The critical items are those which must be performed immediately, without reference to the written checklists, to preclude aggravating the condition and/or avoiding further damage or injury. The critical items in this section are in capital letters and are indicated in the checklist by bold face capital letters. The noncritical items are considered cleanup items which improve the chances for the emergency action to be successful. The nature and severity of the emergency will dictate the degree of compliance necessary; therfore, aircrews must use sound judgment to determine the correct action to be taken. As soon as possible, the pilot should inform all other crewmembers and reporting agencies of the nature of the emergency and the intended course of action to be taken.

DEFINITION OF TERMS.

1. LAND AS SOON AS PRACTICAL: The nature of the emergency allows that a landing be made at the first available safe landing area which provides acceptable access for corrective action.
2. LAND AS SOON AS POSSIBLE: The nature of the emergency dictates that a landing be made at the first available landing area which will assure minimum injury to the crew or minimum damage to the helicopter.
3. EMERGENCY LANDING: An immediate landing will be made regardless of the availability of a suitable landing area. Continued flight may result in serious injury to the crew and substantial damage to the aircraft.

NOTE

For an explanation of illuminated caution/warning lights and initial action, refer to figure 3-1 in this section.

GROUND OPERATIONS.

This phase of operation covers ground or water emergencies that may occur while engines are being started, during taxiing, up to the point where a takeoff is accomplished, and during the ground roll.

When a critical situation dictates an emergency ground egress, the following should be considered: Setting the parking brake, shutting off the throttles, turning off the fuel management system, applying the rotor brake, notifying ground/tower, advising the crew and passengers to evacuate the aircraft, turning the battery switch off and emergency ground egress. These items should be completed on a time permitting basis.

EMERGENCY ENGINE SHUTDOWN AND GROUND EGRESS

The following procedure is (general in nature) and should be used, if applicable, in the event of a ground operation emergency, or following an emergency landing, after accomplishing the appropriate critical items checklist procedures.

1. Parking Brake — Set
2. Throttles — Shutoff
3. Fuel Management System — Off
4. Rotor Brake — On

CAUTION

Application of rotor brake at a higher than normal speed may cause an overheat condition possibly resulting in a fire. If conditions permit apply rotor brake when rotor speed drops below 45% N_R.

5. Radio Call — As Required
6. Aircraft — Evacuate

NOTE

Notify crew/passengers to evacuate the helicopter.

7. Battery Switch — Off

FIRE DURING GROUND OPERATIONS.

Fire in APU Compartment.

If possible, confirm presence of fire by sight or smell before taking action. A fire in the APU compartment would be indicated by the fire warning light on the APU control panel. If an APU compartment fire occurs, proceed as follows:

1. **APU EMERGENCY FUEL – SHUTOFF.**
2. **APU FIRE EXTINGUISHER – (ON).**
3. Master switch — OFF.
4. Fire in APU Compartment checklist completed.

Engine Compartment Fire.

If an engine compartment fire occurs and it is detected visually by the fireguard and/or by activation of the fire warning system, proceed as follows:

1. **THROTTLES – SHUTOFF.**
2. **T-HANDLE (AFFECTED ENGINE) – PULL.**
3. **FIRE EXTINGUISHER – MAIN/RESERVE.**
4. Fuel management system — OFF.
5. APU — OFF.
6. Battery — OFF.
7. Engine Compartment Fire checklist completed.

Flare Case Fire.

If a fire is detected in a flare case, proceed as follows:

a. All personnel — EVACUATED.

b. Fire fighting unit — NOTIFIED.

CAUTION AND WARNING LIGHT – INITIAL ACTION

When caution and warning lights illuminate, the crew should refer to aircraft instruments to verify a malfunction exists, then accomplish the action and procedures as follows for confirmed emergencies.

SEGMENT WORDING	FAULT CONDITION	CORRECTIVE ACTION
GENERATOR (1 and 2)	Generator not connected to bus	Accomplish emergency procedures checklist.
XMFR RECT (1 and 2)	Transformer rectifier not connected to bus	Loss of either TR drops the nonessential DC bus. If both TRs fail, turn off all unnecessary equipment operating off the essential DC bus and land as soon as practical.
FWD/AFT FUEL LOW	140 to 190 pounds (approximately) fuel remaining	Turn on all boost pumps and open cross-feed. If both lights come on, avoid nose-up attitude greater than six degrees.
FWD/AFT FUEL BYPASS	1.5 psi across filter element	Ensure at least one boost pump is on per engine and land as soon as practical.
ENGINE OIL LOW (1 and 2)	Oil quantity down 0.6 gallon from full	Monitor engine instruments and land as soon as practical. Reference ENGINE OIL SYSTEM MALFUNCTION, Section III. Follow Section III, single engine procedures.
TRANS OIL PRESS	Pressure less than 4 psi	Limit flight to 30 minutes. With loss of torque indication rapid rise in N_g/T_5, MGB chip light, MGB oil temperature caution light or temperature indicator at red line, enter autorotation. Reference MAIN GEAR BOX MALFUNCTION, Section III.
TRANS OIL HOT	Temperature above 120°C	Monitor other instruments and land as soon as practical. Reference MAIN GEAR BOX MALFUNCTION, Section III.
AUX/PRIM SERVO PRESS	Pressure below 1000 psi	Accomplish emergency procedures checklist. Land as soon as possible. Reference FLIGHT CONTROL HYDRAULIC SERVO SYSTEM FAILURE, Section III.

SEGMENT WORDING	FAULT CONDITION	CORRECTIVE ACTION
INLET ANTI-ICE (1 and 2)	Boot temperature below 37.8°C (switch on)	Avoid icing conditions. Refer to Engine Air Inlet Anti-Icing System checks in Section IV.
NOSE DOOR	Door not locked	Land as soon as practical, secure door.
CARGO DOOR	Door not locked	Do not open/close door at speeds above 115 KIAS.
BLADE PRESS	Pressure below approximately 6 psi	Accomplished emergency procedures checklist. Reference MAIN ROTOR BLADE IBIS PRESSURE WARNING, Section III.
CHIP DETECTED	Main gear box	Monitor other instruments and land as soon as practical. Reference MAIN GEAR BOX FAILURE, Section III.
	Intermediate/ tail gear box	Land as soon as possible using minimum power. Reference IMPENDING TAIL ROTOR DRIVE SYSTEM FAILURE, Section III.
ALTITUDE LOW	Altitude below index setting	Verify terrain clearance.
ROTOR BRAKE - ON	Hydraulic pressure above 10 (plus or minus 1) psi	Check the rotor brake handle OFF. During flight, if the light remains on, land as soon as possible.
HEATER	Overheat or lack of combustion 45 seconds after heater switch on	Turn off heater. Reattempt use of heater after brief wait. If light remains on, discontinue use.
IFF	Inoperative mode 4 capability due to codes zeroized or system malfunction.	Insert correct codes.

Figure 3-1. Caution Light Panel Indication Chart

USE OF EMERGENCY FUEL CONTROL LEVER TO ASSIST STARTING.

The emergency fuel control lever may be utilized during engine start, in the event a malfunction occurs such as the gas generator failing to accelerate to normal idle speed after engine lite-off (cold hang-up), with N_g, T_5, and fuel flow remaining low. Either engine may be started with the emergency fuel control lever when it cannot be started normally due to engine fuel control unit malfunction. Operation of the emergency fuel control lever bypasses the automatic feature of the fuel control unit to provide fuel scheduling for the engine. Accomplish normal ENGINE STARTING AND ROTOR ENGAGEMENT procedures through the point of advancing the throttle to GRD IDLE.

CAUTION

> Do not open the emergency fuel control lever prior to engine lite-off or a hot start will result.

a. Emergency fuel control lever — ADVANCE SLOWLY TO ACCELERATE GAS GENERATOR TO IDLE SPEED OF APPROXIMATELY 56% N_g.

CAUTION

> Closely monitor T_5 for abnormal temperature rise. If T_5 reaches 840°C, close emergency fuel control lever. If T_5 continues to rise, abort start by pulling down on the throttle and returning to the SHUTOFF position. Be alert for post shutdown fire.

b. Engine instruments — CHECK. Observe N_g, T_5, fuel flow, and engine oil pressure for normal readings. (Closely monitor both engine controls until oil temperature reaches 0°C.)

c. Emergency fuel control lever — CLOSE SLOWLY.

d. If engine continues to run at idle N_g, normal procedures for rotor engagement and engine operation may be followed.

NOTE

If gas generator speed drops off as the emergency fuel control lever is closed, slowly open the emergency fuel control lever to restore idle rpm. This condition is indicative of a fuel control malfunction other than in the automatic start feature. For emergency flight, engage the rotors with the unaffected engine. The emergency fuel control lever of the affected engine will be advanced until N_f matches rotor speed, then advanced, slowly to match torques. Carefully monitor T_5 so as not to exceed 721°C.

EMERGENCY BATTERY START.

The following procedures are in addition to those outlined under ENGINE STARTING in Section VII, and provide the emergency procedures for starting the engines with battery power when 19% N_g cannot be obtained. When advancing the throttle toward GRD IDLE, stop throttle just short of engaging the GRD IDLE detent. If a hot start is evident, retard the throttle cautiously to shut off the fuel without disengaging the starter. As T_5 decreases, advance the throttle to just short of the GRD IDLE detent. This procedure may increase the probability of obtaining an engine start using one battery. If the starter disengages during this procedure, abort the start.

HOT REFUELING

Emergency Procedures

1. Fuel leak/spill:

   a. Shut down refueling operation (HRS)

   b. Determine cause of leak (HRS)

   c. Repair or replace hose or nozzle (HRS)

   d. If unrepairable, terminate refueling operations (HRS/P)

   e. Wash down any fuel spill (HRS)

2. Aircraft Evacuation:

   a. Shut down refueling operation (HRS)

   b. Nozzle and bonding wires removed and clear (HRS)

   c. Clear aircraft to taxi to prebriefed holding area (HRS)

3. Fire/Sparks:

   a. Shut down refueling operation (HRS)

   b. Disconnect hose from tanker and receiver(s) if possible (HRS)

   c. Extinguish fire or determine cause of sparks (HRS)

   d. Evacuate aircraft if necessary (P)

4. First aid for personnel sprayed with fuel:

   a. Immediately flood the contaminated area with large quantities of water, wash with soap if possible.

   b. Remove all contaminated clothing.

   c. Continue irrigation of the contaminated area with water as long as burning persists.

TAKEOFF.

This phase of operation covers emergencies that could occur from the time the takeoff is started from land or water until the initial climb is commenced.

NOTE

The engine failure during takeoff procedures are contained in the INFLIGHT procedures portion of this section.

SINGLE ENGINE TAKEOFFS FROM WATER.

Single engine takeoffs can be executed; however, caution must be exercised as excessive forward speed causes the forward part of the hull to dig into the water.

CAUTION

If the drag caused by the forward hull digging into the water is permitted to increase as power is increased, the helicopter could possibly overturn.

Normally, all takeoffs should be executed into the wind. In high sea states it may be preferable to execute the takeoff slightly off the wind line (30 degrees to waves) in order to minimize wave impact. The most difficult takeoff conditions will result from calm wind, smooth sea states, and high gross weights. Ensure that landing gear is up to avoid drag. The helicopter should be lifted until it sits high in the water (maximum power). A forward taxi should be instituted. As speed is increased, power should be maintained at a maximum. If possible, N_r should not be allowed to droop below 98%. A nose wave will be generated as the helicopter increases speed through the water. Should the helicopter fail to lift upon attaining approximately 10 knots, the pilot may attempt to break the helicopter away from the surface by easing the cyclic stick very slightly aft. Any time the helicopter attempts to "tuck", or dig into the water, the collective should be lowered to minimum and the attempted takeoff aborted. As translational lift is attained, and the sponsons and most of the hull are clear of the water, it may be necessary to ease back on the cyclic stick momentarily to pull the nose of the helicopter out of the water. However, the helicopter should normally lift from the water smoothly and accelerate as drag is lost. The nose attitude will attempt to rise, but should be maintained constant until a minimum of 50 knots airspeed is attained. Once airborne, a minimum of control movements should be made until climb speed is attained. Gradually increase airspeed, being careful not to settle back in the water. Trying to climb too steeply will cause the helicopter to settle. If the helicopter becomes airborne on a single engine takeoff attempt and then tends to settle, the pilot should hold the nose of the helicopter slightly above the horizon and cushion the landing with the remaining rotor rpm and power. Immediately after touchdown, reduce collective pitch lever gently. The success of an attempted single engine takeoff from water depends upon sea state, temperature, gross weight of the helicopter, and wind velocity.

INFLIGHT OPERATIONS.

This phase of operation is from the time the takeoff is accomplished, until the descent is initiated for a landing.

ENGINE FAILURE.

The altitude and airspeed at which engine failure occurs will dictate the action to be taken to effect a safe landing. The airspeed and altitude combinations at which there is no adequate procedure for effecting a safe single engine or power off (dual engine failure) landing are reflected in the Appendix. The majority of turbine engine flameouts are the result of improper fuel flow, caused by fuel control system malfunction. The engine instruments often provide indications of fuel control system failure prior to actual engine failure. A normal air start can often be accomplished. If not, the emergency fuel control can be used to restore engine operation. In the event of apparent mechanical failure within either engine, air starts should not be attempted.

NOTE

In the event of failure of the No. 1 engine or failure of both engines, the APU may be started to insure continued power is available to the accessory section in the event of tail takeoff free wheel unit failure.

ENGINE COMPRESSOR STALLS.

The usual indications of a compressor stall are: torquemeter dropoff to zero, decreasing N_g, and an abnormally rapid increasing T_5. An audible rumble or "choo-choo" sound may or may not accompany the compressor stall. If a compressor stall occurs in flight, immediately retard the throttle to GRD IDLE, then to SHUTOFF if T_5 continues to rise. If a compressor stall occurs, it must be recorded, and if maximum T_5 exceeds 721°C, the temperature and time duration must be recorded. A compressor stall will be recorded and investigated regardless of the temperature reached.

If T_5 returns to within normal limits with speed selector at ground idle and engine is required for return flight, the emergency fuel control may be used to stabilize the engine at or above 95% N_g (95% N_g or above is the range at which the engine is less susceptible to stall). To prevent inducing stall and excessive T_5, use extreme caution in stabilizing engine and use only one power setting if possible. If a sudden/abnormal rise in T_5 is experienced immediately shut down the engine.

CAUTION

Be alert for engine shutdown fire after shutting down a stalled engine.

SINGLE ENGINE FAILURE.

Single Engine Failure During Normal Flight.

If power required at the time of engine failure is less than one engine can sustain at military power, rotor decay is gradual enough to allow a decrease in collective pitch before an excessively low rotor speed is reached. Observe the engine instruments to determine which engine has failed. Engine failure is normally indicated by a rapid decrease in gas generator speed, turbine inlet temperature, power turbine tachometer and torquemeter readings in conjunction with possible loss of engine oil pressure and fuel flow. Immediately upon noticing loss of single engine, reduce collective pitch momentarily to maintain 100% minimum rotor speed and proceed as follows:

1. THROTTLES – MAXIMUM.
2. LANDING GEAR – AS REQUIRED.
3. Weight – REDUCE AS NECESSARY.
4. Accomplish ENGINE SHUTDOWN or RESTART checklist.

WARNING

If icing conditions prevail after a single engine failure, and no foreign object deflector is installed, change altitude to avoid icing if possible. If it is impossible to avoid icing and no foreign object deflector is installed, proceed to the nearest landing area.

Flight Characteristics Under Single Engine Conditions.

The altitude, airspeed, and gross weight at which an engine failure occurs will dictate the action to be followed to effect a safe landing. Level flight can be maintained at low altitude and normal gross weight with standard day conditions, except when hovering or operating at low airspeed. As altitude increases above sea level, maximum gross weight at which level flight can be maintained decreases. At cooler temperatures and light gross weights, the helicopter may have hovering capability in ground effect. (Refer to Single Engine Capability Charts in the Appendix.)

WARNING

During single engine operation the pilot should be prepared to immediately lower the collective should failure of the operating engine occur. Any delay in lowering the collective will result in very rapid N_r decay, possible blade stall, and possible blade to blade contact. Single engine flight with the BAR ALT engaged is not recommended. Loss of the other engine will result in extremely rapid N_r decay.

Altitude Can be Maintained.

If power available is sufficient, initiate a climb at approximately 70 knots to a safe autorotational altitude. Attempt engine restart if determined safe to do so.

NOTE

If the decision is not to attempt a restart, or the restart is not successful, look for a landing site or proceed to destination, whichever is most feasible.

Altitude Cannot be Maintained.

If altitude cannot be maintained on single engine power, an immediate decision must be made as to what course of action should be followed. The decision should be based on power requirements, gross weight, altitude, nature of terrain, or sea state.

NOTE

Airspeed may be decreased to approximately 70 knots if necessary to maintain altitude.

If altitude cannot be maintained at approximately 70 knots, proceed as follows:

a. If altitude permits, and it can be determined that it is safe to do so, attempt an engine restart.

b. Observe rate-of-descent to determine possibility of maintaining level flight at a lower altitude.

c. Gross weight may be decreased by jettisoning external or internal cargo.

d. If steps a., b., and c. do not provide the helicopter with capability to maintain altitude, accomplish a single engine landing.

Single Engine Failure - Hovering and During Takeoff.

HOVERING BELOW 15 FEET.

When hovering at low altitudes (0 to 15 feet) in ground effect, maintain a level attitude and eliminate drift using cyclic control and tail rotor pedals. At these altitudes, if power available is not adequate to prevent touchdown, the collective control should be held fixed or increased as required (to maximum if necessary) to cushion the landing.

HOVERING ABOVE 15 FEET AND DURING TAKEOFF.

When hovering above approximately 15 feet, and during takeoff at airspeeds below approximately 40 knots, power requirements and helicopter control must be closely monitored. The collective pitch lever must be reduced momentarily to retain rotor speed. On takeoff, use cyclic control to decrease airspeed if above 40 knots. If possible, attain about 15 to 20 knots before ground contact, if landing on a smooth surface, or as slow as possible if landing on rough terrain. If in a hover, allow airspeed to increase slightly so that touchdown speeds will be same as for failure on takeoff. Touchdown should be made in a level attitude with an absolute minimum of drift. Just before touchdown, increase collective control as required to cushion landing. If landing on a smooth surface, allow the helicopter to roll forward slowly as brakes are applied.

ENGINE SHUTDOWN IN FLIGHT.

1. Throttle — SHUTOFF.
2. Ignition switch — OFF.
3. Fuel shutoff valve — CLOSED.
4. Boost pumps — AS REQUIRED.
5. Fuel crossfeed valve — AS REQUIRED.
6. Engine anti-ice — OFF.
7. Engine Shutdown checklist completed.

CAUTION

If an engine fire should occur and the corresponding engine fire warning light illuminates during or after engine shutdown, proceed with steps 3 through 6 of Engine Compartment Fire in Flight Checklist.

ENGINE RESTART DURING FLIGHT.

Try to determine cause of engine failure and if it is safe to attempt a restart in flight. If it is decided to attempt a restart, proceed as follows:

1. Ignition switch — NORMAL.
2. Throttle (inoperative engine) — SHUTOFF.
3. Emergency fuel control lever — CLOSED.
4. Fuel shutoff valve — OPEN.
5. Boost pumps — AS REQUIRED.
6. Fuel crossfeed valve — AS REQUIRED.
7. Engine — START.
8. Engine Restart During Flight checklist completed.

CAUTION

- A failed engine can be restarted in flight when it has been determined that it is reasonably safe to do so. Before attempting a restart, allow 30 seconds of gas generator coast down, with the throttle in the SHUTOFF position, to purge the engine of fumes and fuel. Power turbine inlet temperature (T_5) should be less than 100°C and gas generator speed 19% N_g prior to advancing the throttle to GRD IDLE, to avoid a hot start. However, in the event power is required immediately from the failed engine to sustain flight, a restart may be attempted, provided N_g is 38% or below. Enter the N_g starter engagement in the Form 781. Starter and accessory drive damage can be anticipated.
- When it is suspected that engine failure has resulted from contaminated fuel, the fuel crossfeed valve should be closed for the attempted restart to prevent the possibility of fuel from the contaminated tank flowing to the operative engine. If the attempt to restart fails, and a subsequent attempt to restart is made with the crossfeed valve open, the boost pumps in the tank feeding the inoperative engine should be off to prevent the possibility of fuel from the contaminated tank flowing to the operative engine.

GO-AROUND WITH ONE ENGINE INOPERATIVE.

(See figure 3-2.)

If before landing, it is determined that a safe landing cannot be made, and power available is sufficient to continue flight, initiate a go-around as early as possible to regain or maintain airspeed. Increase collective pitch to obtain maximum single engine torque up to 123% Q, while maintaining a minimum rotor speed of 98% N_r. Increase airspeed to 70 to 80 knots and establish a climb.

FAILURE OF BOTH ENGINES.

Should both engines fail, a safe autorotative landing can be accomplished except when flying at low airspeed and altitude conditions shown in the shaded areas of the Height Velocity Diagram - Two Engine Failure, in the Appendix. Continuous operation in the shaded areas should be avoided. The height-velocity diagram is meant to depict the capabilities of the helicopter, as flown by an average pilot over a paved runway, with zero wind. Under operational conditions, the altitude-airspeed combination for a safe autorotative landing is dependent upon many variables such as pilot capabilities, density altitude, helicopter gross weight, proximity of a suitable landing area, and wind direction and velocity in relation to flight path. This does not preclude any operation in the shaded area under emergency or pressing operational requirements, as a controlled landing can usually be accomplished, and minimum damage, if any, will occur to the helicopter. Generator power will be available even during times of lower rpm. Immediately upon a two-engine failure, rotor rpm will decay and the helicopter will yaw and roll to the left. This is due to the loss in power and corresponding reduction in torque. Except in those instances when a two-engine failure is encountered in close proximity to the surface, it is mandatory that autorotation be established by immediately lowering the collective pitch to minimum. Heading can be maintained by depressing the right tail rotor pedal to decrease the tail rotor thrust. Autorotative rpm will vary with ambient temperature, pressure altitude, increases in "g" loading such as in turns, and gross weight conditions. High gross weights, increased "g" loads, and higher altitudes and temperatures will cause increased rpm which can be controlled by increasing collective pitch. If altitude permits, a restart can be accomplished or emergency fuel control may be used to restore engine operation.

WARNING

If collective pitch is not reduced sufficiently to effect a safe recovery, control will be lost when rotor speed decreases to the point at which blade stall is encountered. The point at which blade stall will occur is dependent upon density altitude, airspeed, and gross weight factors.

Two-Engine Failure While Hovering.

Settling will be rapid, and immediate application of right pedal is necessary to maintain a heading. At

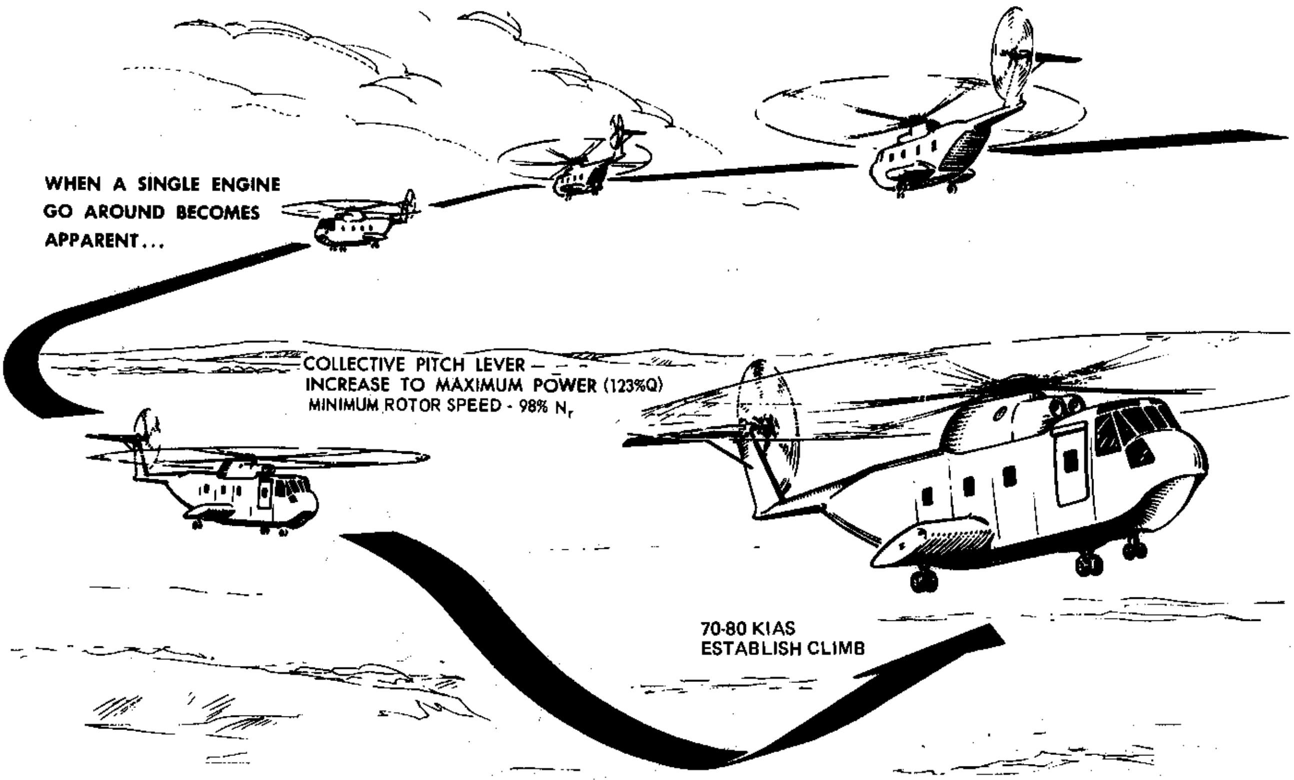


Figure 3-2. Single Engine Go-Around (Typical)

low altitudes, landings can be cushioned by increasing collective pitch as the helicopter settles to the ground. Do not reduce collective pitch as in the event of both engines failing at higher altitudes. In this case, a reduction of pitch will cause the helicopter to settle more rapidly. At touchdown, the helicopter should be held in a level attitude. When contact is made with the ground, the cyclic stick should be moved slightly forward of the neutral position. Regardless of the force with which the helicopter strikes the ground, damage will be much less if it strikes level. After ground contact is made, reduce collective pitch to minimum and apply wheel brakes, and rotor brake.

Two-Engine Failure During Takeoff and Climb (Below 60 KIAS).

After the climb has been started, various techniques may be employed to execute a power-off landing. When two-engine failure is experienced and altitude permits, reduce collective pitch to maintain rotor speed, accomplish a moderate flare, and reduce airspeed to below 40 knots before ground contact. Attain a level attitude at ground contact and increase collective pitch to cushion landing. After ground contact, reduce collective pitch to minimum and apply wheel and rotor brakes.

Two-Engine Failure During Flight (Autorotative Landing).

(Refer to figure 3-3.)

In the event of a two-engine failure during flight, a safe autorotative landing can be accomplished provided the helicopter is being flown at a safe altitude-airspeed combination and the inflight altitude is sufficient to permit selection of a suitable landing area. A site for autorotative landing should be the same as for single-engine landings, as ground contact should be made with some forward airspeed. Immediately upon encountering dual engine failure, reduce collective smoothly to minimum setting

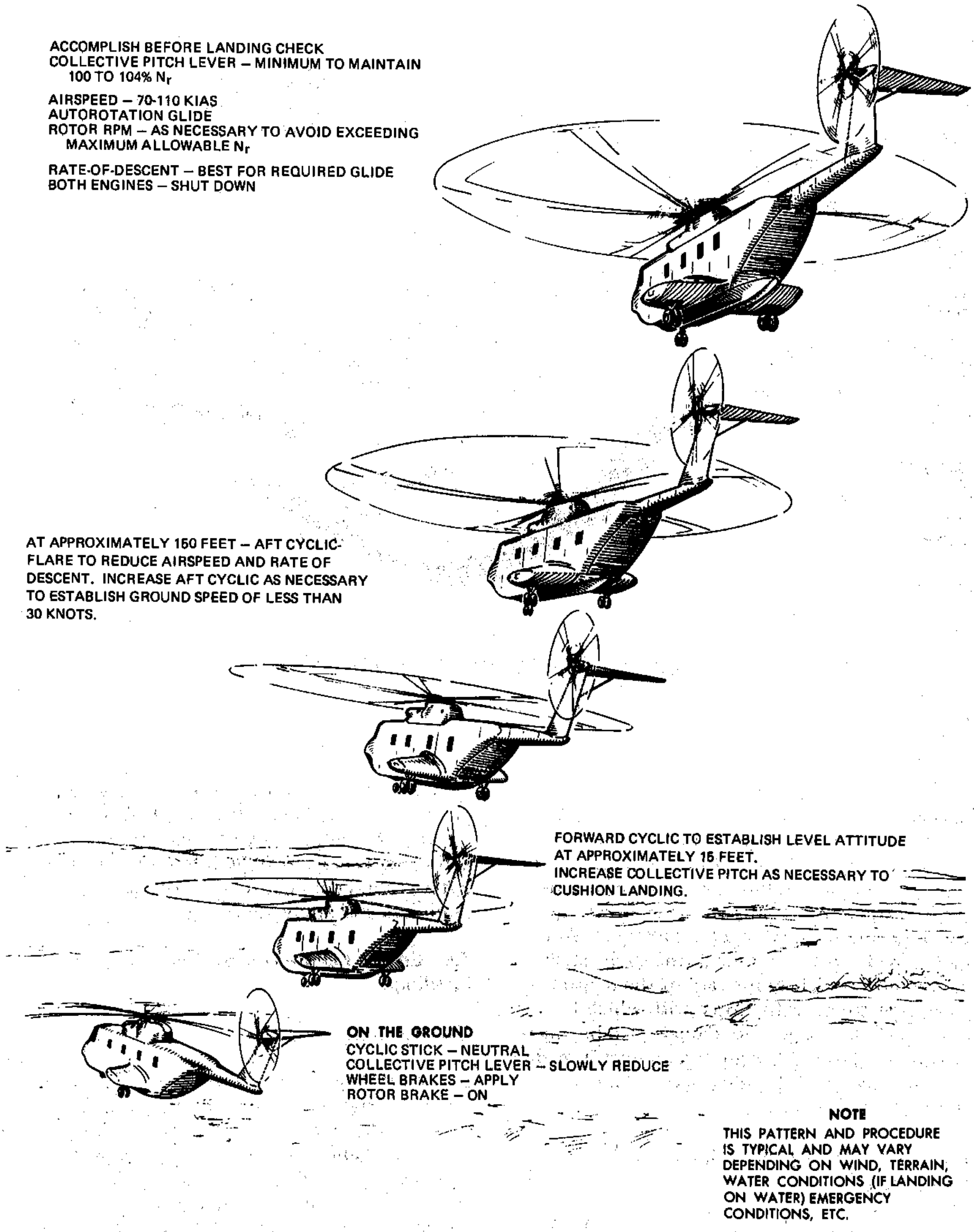


Figure 3-3. Autorotative Landings (Typical)

to maintain a rotor speed of 100 to 104% N_r. Adjust cyclic stick as necessary to maintain 70 to 110 knots. Minimum rate of descent and maximum autorotative gliding distances are shown in figure 3-4. Any increase of rotor rpm other than specified for maximum glide will result in a greater rate of descent. Therefore, if time permits, adjusting the collective pitch lever to produce the desired rotor rpm will result in an extended glide. At an altitude of approximately 150 feet, a flare should be established by moving the cyclic stick aft with no change in collective pitch. This will decrease both airspeed and rate of descent and cause an increase in rotor rpm. The amount that the rotor rpm will increase is dependent upon the rate that the flare is executed. An increase is desirable because more energy will be available to the main rotor when collective pitch is applied.

NOTE

- Under certain light gross weights and low temperatures, rotor speeds may not build up to 100% N_r on straight-away autorotations.
- All autorotative landings should be made into the wind, if possible.

Maintain helicopter control and initiate autorotation.

1. COLLECTIVE – DOWN.
2. LANDING GEAR – AS REQUIRED.
3. Throttles — SHUTOFF.
4. Ignition switches — OFF.
5. Fuel shutoff valves — CLOSED.
6. Boost pumps — OFF.
7. Battery — OFF.
8. Autorotation checklist completed.

While initiating a flare at approximately 150 feet, attain a ground speed of less than 30 knots with cyclic control. Level off at approximately 15 feet, while eliminating all drift and maintaining a level attitude until touchdown. Just prior to touchdown, increase collective pitch to cushion landing. After ground contact, slowly reduce collective to minimum pitch, and apply rotor and wheel brakes.

WARNING

When entering autorotation, avoid abrupt cyclic movements. 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 throttles prior to entering autorotations and/or rapid reduction of collective pitch especially at reduced rotor rpm. Following a loss of power, do not apply either rapid collective and/or cyclic control inputs or large displacement cyclic inputs with the collective full down.

Two-Engine Failure At High Power.

A two-engine failure at high power during high or low speed flight, climb, and hover out of ground effect, will result in rapid rotor rpm decay, and will be accompanied by a distinct yaw and roll to the left. Collective pitch must be immediately reduced to prevent excessive loss or rotor rpm, and right tail rotor pedal should be applied to compensate for loss of torque and to control heading.

Two-Engine Failure At High Power and Low Speed.

Reduce collective pitch to minimum and simultaneously apply forward cyclic stick to regain airspeed and establish a glide at a minimum airspeed of 70 knots. This action normally requires 400 to 500 feet of altitude if the recovery is initiated at zero airspeed. Accomplish landing as outlined in Two-Engine Failure During Flight (Autorotative Landing) in this section.

Two-Engine Failure At High Power and High Speed.

If a constant airspeed is maintained while normal recovery procedures are being used, a loss of approximately 300 to 500 feet of altitude will be realized. This altitude loss may be reduced by simultaneously applying aft cyclic stick as the collective pitch is reduced. The rate that aft cyclic stick is applied, and the duration of the corresponding nosehigh attitude, determines the rate of deceleration and/or loss of altitude. Judicious use of collective pitch during the flare, to keep rotor rpm from building up, also reduces the loss of altitude. Accomplish landing as outlined in Two-Engine Failure During Flight (Autorotative Landing) in this section.

Two-Engine Failure At High Speeds and Low Altitude.

The following procedure should be used if both engines should fail at high speed and low altitude: Immediately lower collective pitch and simultaneously apply aft cyclic stick to hold the helicopter off the surface. Accomplish landing as outlined in Two-Engine Failure During Takeoff and Climb in this section.

NOTE

Avoid abrupt control movements during high speed autorotation to preclude rotor overspeed and/or blade stall.

TAIL ROTOR SYSTEM FAILURES.

Tail rotor system failure can be generally classified as drive system failure and as control system failure. The information that follows is based on flight tests in which a drive system failure resulting in loss of the tail rotor thrust was simulated. In either case, very little factual data can be drawn from this experience. Consequences of tail rotor failure may vary widely and will require the utmost in pilot technique. The case of a control system failure is believed to be less critical than drive system failure and was not covered during the tests.

NOTE

The auxiliary servo may give a hardover input in either direction and can be distinguished from tail rotor drive system failure by a single uncoupled force in the tail rotor pedals. Turn the auxiliary servo off to restore manual control.

IMPENDING TAIL ROTOR DRIVE SYSTEM FAILURE.

Illumination of the chip detector caution light and the intermediate or tail chip detector warning lights indicates the presence of metallic particles in the respective gear box, and may be an indication of forthcoming tail rotor drive system failure. If either the intermediate or tail gear box chip detector warning light should illuminate, the following action should be taken by the pilot:

a. Land as soon as possible. If a suitable site is not available (rough terrain, over water with high sea state or at night), attain a safe autorotation altitude/airspeed (500 feet/70 knots), and proceed to the nearest suitable landing site.

b. Descent and approach should be made with minimum power to facilitate entry into autorotation if tail drive failure occurs. A running or no hover landing utilizing minimum power should be executed as conditions dictate. High power settings require maximum performance of the tail rotor drive system and may precipitate ultimate drive failure.

WARNING

If the illumination of the chip detector caution light is accompanied by strong intermediate frequency vibrations, hot metal, oil fumes, or smoke in the pylon or aft station area or any other indications of impending tail rotor drive failure, the pilot shall make an emergency landing.

Tail Rotor Drive System Failure.

A tail rotor drive system failure, whereby tail rotor rpm and thrust are lost, may be caused by fracture of the shaft, coupling, or gear box, or by separation of the tail rotor assembly from the helicopter. Tail rotor separation from the helicopter is usually caused by severe vibration that has been induced by the fracture of a rotating component. A drive system failure is the most difficult type for the pilot to cope with, as it is accompanied by the loss of the rotating disc area that would normally assist as a stabilizing fin in forward flight.

Since tail rotor drive system failure at high speeds is expected to produce violent helicopter response, recognition of impending failure is extremely important. Excessive vibration of noise in the tail section usually precedes tail rotor drive system failure. Therefore, when this occurs, airspeed should be reduced immediately to the best autorotational speed.

A tail rotor drive system failure is always accompanied by loss of directional control and a sharp yaw to the right. The rate and amount of yaw are governed by the power applied and the airspeed. The yaw tendency can only be reduced by immediate reduction in power.

Yaw angles in excess of 50 degrees can be expected. Immediate entry into autorotation will reduce the yaw angle.

WARNING

Extended flight is not possible after tail rotor drive system failure. Autorotation must be entered immediately.

Because of the extremely hazardous nature of the landing, it is recommended that the helicopter be abandoned, if parachutes are worn and if sufficient altitude and time are available. Crew bailout via the right side is recommended.

If a landing is to be performed:

a. Establish autorotation.

b. Maintain approximately 70 KIAS. The airspeed indicator, although in error, will indicate the approximate airspeed.

c. Landing gear — AS REQUIRED.

d. Throttles — SHUT OFF.

If sufficient altitude is present at time of autorotation, the pilot can minimize aircraft yaw to near balanced flight by assuming a new flight path based upon aircraft heading after initial yaw. Initiate a flare at approximately 150 feet to reduce rate of descent and ground speed. If sufficient altitude is not present at the time of autoroation to assume a new aircraft flight path, the pilot may be forced to fly in a side slip condition. Due to this, higher rates of descent will be experienced and the pilot will be required to initiate a moderate sideways flare at approximately 150 feet to reduce rate of descent and ground speed.

NOTE

Ground contact speed must be held to a minimum as a sideslip condition may cause rollover on touchdown.

Tail Rotor Drive System Failure While Hovering.

a. If hovering above 10 feet, decrease collective to descend and reduce rate of aircraft rotation.

b. Maintain level attitude and correct drift with cyclic.

c. Throttles to SHUTOFF at approximately 10 feet.

d. Increase collective as necessary to cushion landing.

NOTE

- Rate of rotation is directly proportional to main rotor torque; therefore, decreased collective will reduce main rotor torque and rate of rotation. If throttles are shut off above 10 feet, a hard landing may damage the aircraft.

- Loss of tail rotor authority may be misinterpreted as tail rotor drive system failure. This condition could be encountered due to combinations of drift, turn rate, low N_r, and torque values exceeding dual engine limitations. If under these conditions directional instability with right rotation of the aircraft is encountered, immediately reduce collective and transition into forward flight to restore directional stability.

Tail Rotor Control System Failure.

A tail rotor control system failure forward, at or aft of the auxiliary servo will result in a loss of tail rotor response.

a. Tail rotor control failure forward of the auxiliary servo.

(1) Tail rotor pedal linkage becomes disconnected from the auxiliary servo.

(a) Symptoms: Sloppiness in tail rotor pedals, aircraft does not respond to tail rotor inputs and maintains heading at time of failure.

(b) Corrective action: Use AFCS yaw trim knob to make heading changes and land as soon as possible. If AFCS becomes inoperative, consideration may dictate turning off the auxiliary servo to allow the negative force gradient spring to place a constant pitch on the tail rotor.

b. Tail rotor control failure at the auxiliary servo.

(1) Symptoms: Tail rotor pedals lock up and will not respond to inputs, or go hard over in either direction and will not respond to an input in the opposite direction.

(2) Corrective Action: Turn off the auxiliary servo. Normal aux off flight should then be able to be conducted.

c. Tail rotor control failure after the auxiliary servo. This failure will be discussed in two parts. The first, control cable separation or slippage not resulting in a jammed cable; second, control cable separation or slippage that results in a jammed cable. In either case the tail rotor will continue to rotate in some value of positive thrust.

(1) The first situation, cable separation or slippage not resulting in a jam, will automatically place the negative force gradient spring into play. This spring, when operating in normal forward flight, will place a positive load upon the tail rotor driving it to a positive pitch. This pitch is adequate to compensate for torque loads that occur at or around slow cruise (60-80 knots, 40-50 percent torque) up to max gross weights at 100 percent N_r. The amount of torque to maintain the aircraft in balanced flight will vary with aircraft weight and tail rotor rpm. Consideration may also be given to placing the throttles to maximum which will result in driving the tail rotor at a faster rpm which will result in a more effective anti-torque device.

(a) Symptoms: Aircraft will not respond to tail rotor inputs and will probably yaw right depending upon airspeed and torque loads. In a hover, the aircraft will gradually start yawing right building up speed as in a tail rotor drive loss.

(b) Corrective Action: In hover, treat as a tail rotor drive loss. In flight, experimentation must be conducted to derive a proper torque and airspeed as stated in description of failure. Land as soon as possible.

(2) The second situation, cable separation or slippage that results in a jammed tail rotor cable, is less critical due to the fact that the tail rotor will probably maintain that pitch at the time of the failure.

(a) Symptoms: If this occurs during hover, the aircraft will maintain close to the heading at time of a failure. The pilot will notice that the aircraft will not respond to tail rotor inputs. There could be a similarity between this failure and that of tail rotor control failure forward of the auxiliary servo. Pilot will notice aircraft will have greater left and right yaw tendencies as collective is moved and will not return to original heading as it would if AFCS was holding the heading. In forward flight, yaw tendencies would be reduced.

(b) Corrective Action: In hover, land; as collective is reduced expect a slight yaw to the left. In flight, experimentation must be conducted to determine airspeed and torque required to maintain the aircraft in balanced flight. Land as soon as possible.

(3) In either of the two situations mentioned, a run-on landing will be required, possibly in excess of 40 knots. Practice approaches should be conducted at altitude to determine maximum torque versus minimum airspeed to preclude error during the actual approach.

MAIN ROTOR BLADE IBIS PRESSURE WARNING.

(For aircraft modified by TCTO 1H-3-661)

Illumination of the BLADE PRESS caution light indicates possible loss of pressure in one or more main rotor blade spars with corresponding potential for impending spar failure.

1. Airspeed — Attain 70 to 90 KIAS.

NOTE

The 70 to 90 knot speed restriction will reduce the vibratory stresses in the main rotor blade spar and significantly increase the crack propagation time.

2. Land as soon as practical and visually check the IBIS indicators.

IBIS Visual Check.

a. If red is visible in any indicator, the helicopter will not be flown until corrective maintenance has been performed.

NOTE

- Blade pressure caution light may illuminate on rotor engagement due to temperature change if main rotor blades were heated by engine/APU exhaust.
- If BLADE PRESS caution light illuminates during flight, land as soon as practical. If red is visible on any indicator, it may be reset one time. If it remains reset after a fifteen minute ground run, the helicopter may be cleared for a one time flight back to base.

b. If all IBIS indicators are yellow and the BLADE PRESS caution light remains on, the helicopter may be cleared for flight but is limited to 70 to 90 KIAS and 3 hours for the purpose of returning to a base where maintenance action can be performed.

EMERGENCY JETTISONING OF AUXILIARY FUEL TANKS.

The external auxiliary fuel tanks may be jettisoned at the discretion of the pilot to reduce weight, etc. The tanks may be jettisoned electrically by actuating the switches located on the auxiliary fuel control panel or mechanically by pulling the emergency auxiliary tank release handle located aft of the cockpit console. Tanks may be jettisoned electrically, individually or simultaneously. Manual jettison will release both tanks simultaneously.

CAUTION

Do not perform an asymmetric jettison of the external fuel tanks during climb as excessive roll rates and attitudes may occur.

If, for any reason, one external tank is dropped and fuel remains in the tank being carried, continue to transfer fuel into the main tank. Monitor the fuel gages and use crossfeed to maintain fuel management between forward and aft tank. Refer to Section V for JETTISON OF EXTERNAL FUEL TANKS LIMITATIONS.

FIRE IN FLIGHT.

ENGINE COMPARTMENT FIRE IN FLIGHT.

Engine compartment fires are usually the result of an engine malfunction or failure of one of its component systems. Ruptured fuel and oil lines will usually be detected by engine instrument indications. If possible, confirm the presence of fire by other indications.

NOTE

Hovering downwind, or in a calm wind, may cause the fire warning system to activate due to recirculation of hot gases through the engine. It is possible to receive a false fire warning light due to warning system malfunction. If possible, confirm the presence of fire by sight, smell, sound or reference to engine instruments before proceeding with the checklist.

1. THROTTLES – MAXIMUM.
2. THROTTLE (AFFECTED ENGINE) – SHUTOFF.
3. T-HANDLE (AFFECTED ENGINE) – PULL.
4. FIRE EXTINGUISHER – MAIN/RESERVE.
5. LANDING GEAR – AS REQUIRED.

NOTE

If one fire extinguisher container has been discharged, check to ensure the FIRE EXT circuit breaker is set before discharging the remaining bottle.

6. Weight — REDUCE AS NECESSARY.
7. Accomplish Engine Shutdown In Flight checklist.

CONSECUTIVE FIRES IN BOTH ENGINE COMPARTMENTS.

When a fire has been experienced in an engine compartment that necessitates using the fire extinguisher system, and a subsequent fire is experienced in the other engine compartment, enter autorotation and follow procedures for ENGINE COMPARTMENT FIRE IN FLIGHT for the second engine, except select RESERVE position of the engine fire extinguisher switch. Accomplish landing as outlined in Two-Engine Failure During Flight (Autorotative Landing).

SIMULTANEOUS FIRES IN BOTH ENGINE COMPARTMENTS.

If simultaneous engine fires occur, enter autorotation and put both throttles in the SHUTOFF position. After shutting off fuel to the engines, pull the selected fire emergency T-handle and move the engine fire extinguisher switch to the MAIN position. Fire extinguisher agent will then be released into the selected engine compartment. Pull the opposite fire emergency T-handle and move the engine fire extinguisher switch to the RESERVE position, releasing fire extinguisher agent into the opposite engine compartment. Accomplish landing as outlined in Two-Engine Failure During Flight (Autorotative Landing).

WARNING

Do not reset the first fire emergency T-handle before attempting to extinguish the second fire. This could result in allowing fuel to re-enter the first engine.

NOTE

The second fire bottle will discharge into the last engine for which the T-handle was pulled, regardless of the position of the first fire emergency T-handle. There will be no extinguisher available if both MAIN and RESERVE were used on the first fire.

FUSELAGE/ELECTRICAL FIRE.

a. Discharge fire extinguisher at fire or jettison burning items.
b. Windows and doors — CLOSED.
c. Vent fan switch -- NORMAL.
d. Land as soon as possible if fire persists.

In the event of an electrical fire, attempt to isolate the affected circuit by pulling circuit breakers. If flight conditions permit, turn off generators and battery if necessary to isolate the problem.

FLARE CASE FIRE.

If a fire occurs in a flare case, an internal sensing unit will jettison the case automatically. If the automatic jettison fails, jettison flare case electrically by use of the flare case jettison switch or manually jettison by use of the manual jettison lever.

SMOKE, FUME, AND ODOR ELIMINATION.

After a fire, or if fumes are detected in the helicopter, open the personnel door and the pilot's compartment windows for the elimination of smoke and/or fumes. Flight tests indicated these two openings are the most effective for smoke and fume elimination. Normally no toxic quantities of carbon monoxide gas or other gases are present from the engine exhaust. Objectionable odors of the engine exhaust gases, which are sometimes encountered in the helicopter during ground runup, taxiing, slow speed flight, or single engine flight with one engine in ground idle may be avoided by heading the helicopter into the wind and/or closing the pilot's compartment window and the personnel door. Opening the personnel door and the pilot's compartment windows in flight will assist in removing the objectionable fumes and odors. If aft ramp is open or removed, the aircraft must be yawed to the left to remove smoke and fumes. All odors not identifiable by the flight crew shall be considered toxic. If an unidentifiable odor is detected, ventilate the aircraft and land as soon as practical.

WARNING

- Do not open the pilot's compartment windows if personnel door is not open because, with personnel door closed, the smoke and fumes will enter the pilot's compartment.
- Smoke accumulation in the aft cabin that cannot be eliminated by normal smoke and fume elimination procedures may be an indication of impending intermediate gear box failure. Follow procedures for IMPENDING TAIL ROTOR DRIVE SYSTEM FAILURE.

CAUTION

Do not jettison any windows, the door, or the emergency hatch while the helicopter is in forward flight as they may be carried into the rotor blades.

BAILOUT.

The decision to bailout is the pilot's, based upon evaluation of all factors at the time of the emergency and is recommended if it is impossible to make a safe emergency landing. Minimum bailout altitude should be 1000 feet above the surface. Bailout should be accomplished in level flight at approximately 70 KIAS; however, bailout is possible during autorotation.

WARNING

To avoid contacting sponsons during bailout the following speeds should not be exceeded:
140 KIAS Maximum Powered Flight.
125 KIAS Maximum Autorotation.

Prior to abandoning the aircraft (time permitting), the IFF should be placed in emergency and a radio call accomplished. Cabin occupants should abandon the aircraft via the personnel door by diving down to avoid contact with the sponson. Arms should be held close to the body with the head down; wait until clear of the helicopter before opening the parachute. The pilot may, at his discretion, have personnel bailout through the ramp exit. However, no more than one person should be on the ramp at any one time to avoid a CG problem. The pilot may exit through the cockpit sliding windows or the personnel door as circumstances dictate. Time of exit through the window or door is approximately the same. If exit through the window is attempted, jettison the window, place both feet in the seat with hands on the window frame and dive down and out to clear the helicopter. Open the paracute when clear of rotor turbulence.

WARNING

The copilot must ensure that the collective pitch lever does not block his egress through the window. The pilots must also ensure that their helmet cords are not entangled in their shoulder harness. If armor plating is installed, the outboard wing armor must be released prior to attempting to bailout. The pilots' seats must not be in the full down position when the outboard wing armor is released as the armor may not clear the window opening. If time and altitude permit, accomplish the following checklist.

1. IFF — EMERGENCY.
2. Radio call — MAYDAY (Give position report).

3. Cabin occupants — ALERTED (Warn occupants via interphone, loudspeaker or alarm bell.)

4. Personnel door — OPEN (Jettison if necessary.)

5. Cabin occupants — BAILOUT.

6. Pilot and copilot — BAILOUT.

LANDING.

This phase of operation is from the time a descent is commenced to initiate a landing until the helicopter has touched down. This phase also contains appropriate emergency water operating procedures.

EMERGENCY DESCENT.

There is no set procedure for an emergency descent. Damage to the helicopter or engines must be considered secondary to getting the helicopter on the ground. During an extreme emergency, the condition or type of landing may be the determining factor in the type of emergency descent to be made. If a long distance must be covered to a selected landing site, a dive with power would be most feasible. A normal power-on vertical landing may be made when the landing site is reached. If a short distance must be covered to a selected landing site, attaining a rapid rate of descent with low power, minimum pitch, and slow forward speed is the most practical means of accomplishing an emergency descent.

MAXIMUM AUTOROTATIVE GLIDE DISTANCE CHART.

The maximum autorotative glide distance chart (figure 3-4) shows the maximum gliding distance attainable if power fails on both engines. Maximum autorotative gliding distance is obtained at 110 KIAS and approximately 104% rotor speed. The rate of descent is approximately 2300 feet per minute. Minimum rate of descent is obtained at 70 KIAS and 104% rotor speed. Minimum rate of descent is approximately 1900 fpm. Increasing rotor speed above 104% will result in a greater rate of descent and reduced gliding distance.

SINGLE ENGINE LANDINGS.

(Refer to figure 3-5.)

Single engine landings can be safely accomplished provided they are not initiated within the airspeeds and altitudes shown in the areas to avoid on the Height Velocity Diagram in the Appendix. After a suitable landing site has been selected, maintain approximately 70 knots until a safe landing is assured. Adjust collective pitch and cyclic control to gradually decrease airspeed and rate of descent. Maintain level attitude and minimum practical rate of descent prior to ground touchdown. If landing on an unprepared surface or a confined area, dissipate speed gradually throughout the approach to touchdown as slow as possible to minimize ground roll. Upon ground contact, smoothly reduce collective pitch lever and control cyclic stick to maintain level attitude. Reduce the collective pitch to minimum and apply brakes to minimize the ground roll.

CAUTION

Extreme nose-high attitudes must be avoided near the surface (10 to 15 feet altitude) due to possibility of the tail pylon striking the ground. If collective pitch is increased prematurely, insufficient rotor speed may remain to cushion the landing, resulting in possible damage to the aircraft.

SINGLE ENGINE WATER LANDINGS.

A single engine landing on the water differs only slightly from that on a hard surface. However, it is necessary that touchdown speed be somewhat slower, especially over rough water, and that the rate of descent be controlled. Upon water contact (20 knots or less), reduce collective pitch slowly as the helicopter settles into the water.

CAUTION

Do not exceed 10 degree noseup attitude at touchdown on calm water, or 7 degrees in sea state one or above, to avoid tail pylon water contact.

MAXIMUM AUTOROTATIVE GLIDING DISTANCE

212 ROTOR RPM 104% ROTOR SPEED

MODELS: CH-3E & HH-3E
DATE: 1 JUNE 1965
DATA BASIS: CONTRACTOR FLIGHT TEST

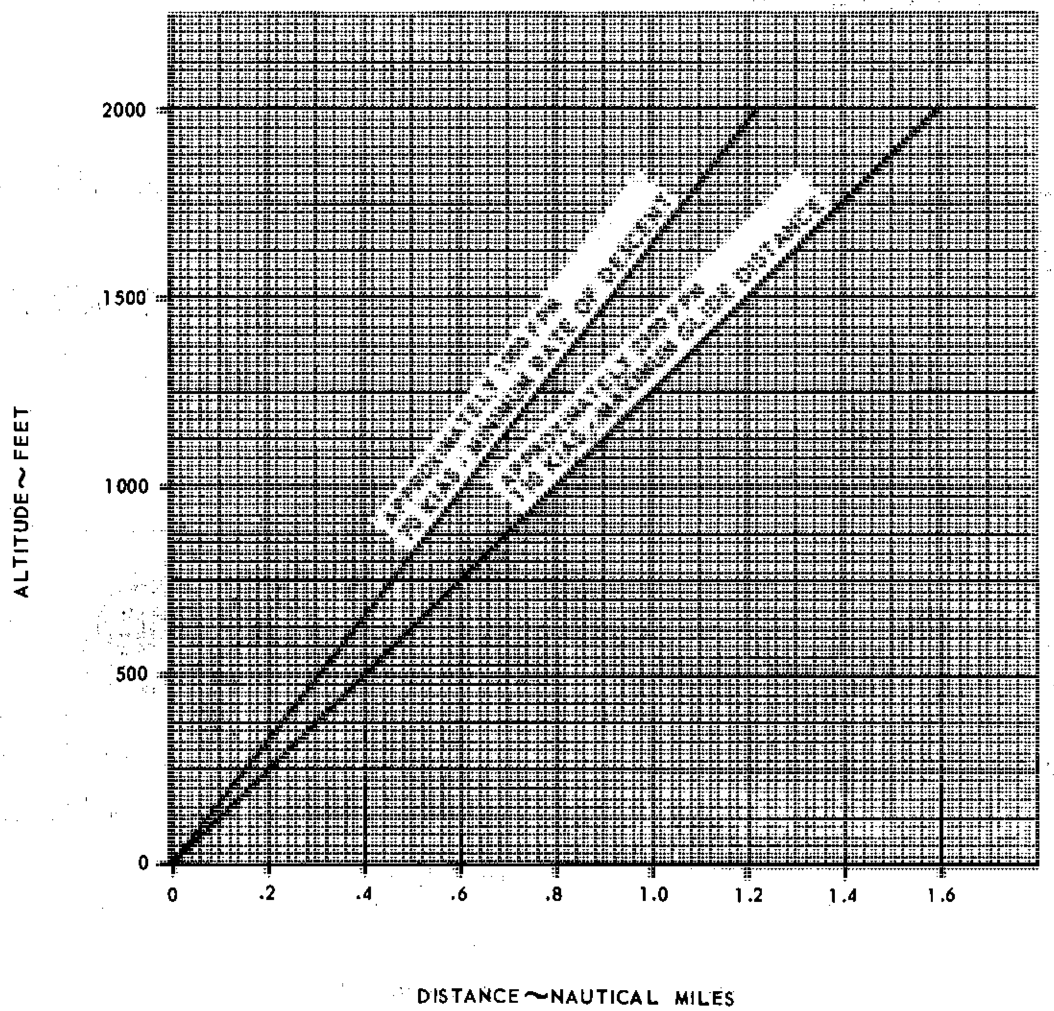


Figure 3-4. Maximum Autorotative Gliding Distance

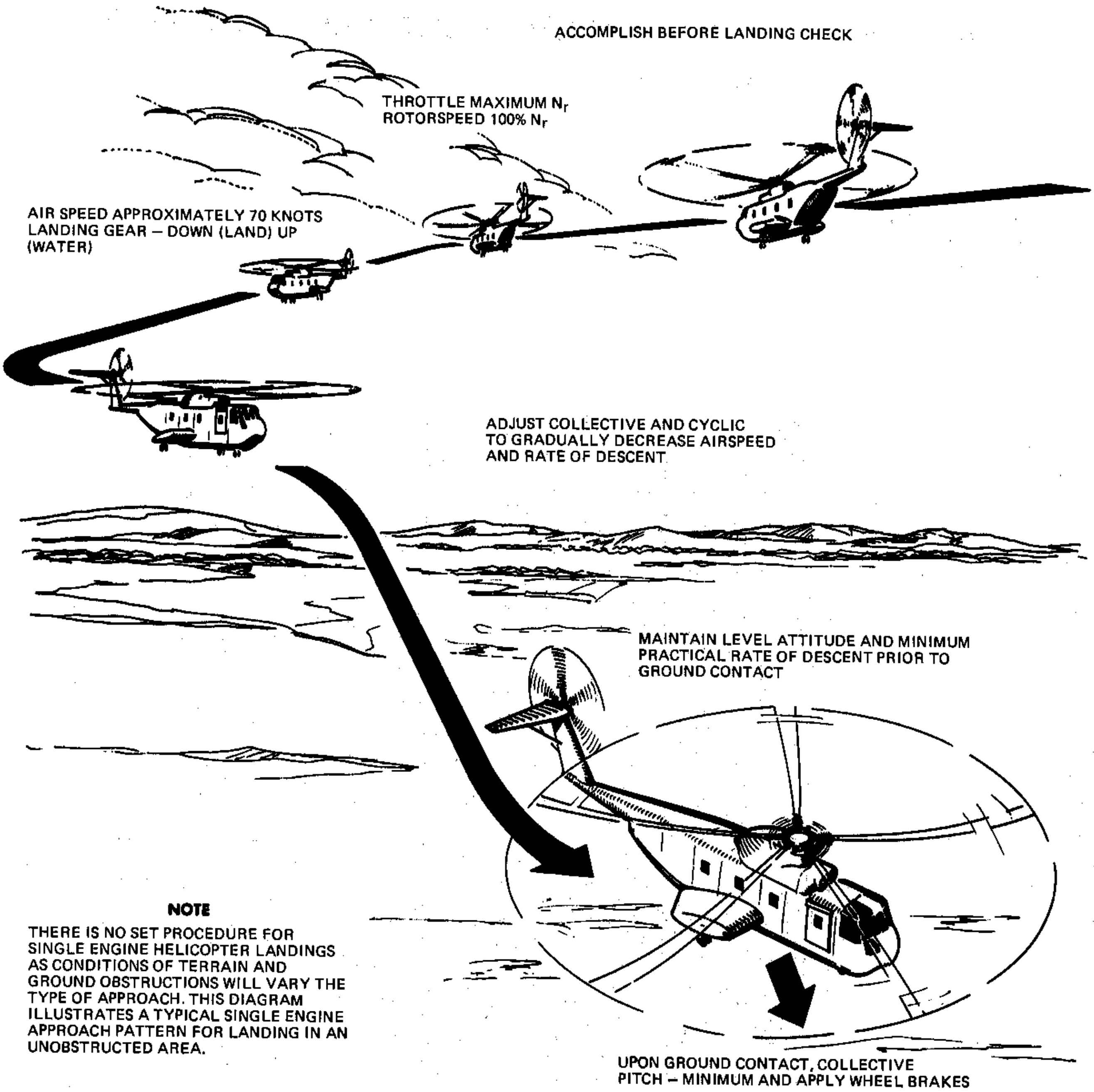


Figure 3-5. Single Engine Approach (Typical)

PRACTICE SINGLE ENGINE LANDINGS.

Practice single engine approach and landings may be performed in the same manner as described under SINGLE ENGINE FAILURE in this section except that only the first item of the checklist will apply. Single engine failure is simulated by retarding either throttle until the N_f needle falls to 96 - 98% N_f.

AUTOROTATIVE LANDINGS.

Refer to Two-Engine Failure During Flight (Autorotative Landing), outlined under INFLIGHT procedures in this section.

WATER AUTOROTATIVE LANDINGS.

Autorotative landings on water differ from autorotative landings on land in that touchdown speed must be held to a minimum (less then 20 knots) and the descent from flare to water contact should be as near vertical as possible. After touchdown reduce collective slowly to minimum pitch. After collective is lowered, use tail rotor pedals to turn so that the nose of the helicopter is approximately 30 degrees to the waves. Allow the rotor to decelerate to a stop without applying the rotor brake. When rotor slows to a stop, deploy anchor to prevent helicopter from drifting ashore.

NOTE

- The flare should be executed high enough to permit the airspeed and rate of descent to be reduced sufficiently to level the helicopter for a near vertical descent.
- If a sudden emergency exit from the helicopter is desired, rotor brake should be applied. Applications of the rotor brake at high N_r may result in excessive roll angles and possible upset in rough water.

PRACTICE POWER RECOVERY AUTOROTATIONS.

Practice power recovery autorotations will be entered at an airspeed of 70 to 110 KIAS and a minimum altitude of 500 feet AGL. To enter a practice power recovery, the pilot flying the helicopter will reduce the collective pitch to minimum and instruct the designated crew member monitoring the throttles to retard both throttles to 98 to 100%N_f. This will usually effect a clean needle split. Should the N_f not split from N_r, indicated torque values of less than 10% effectively place the helicopter in an autorotative descent. The throttles should be monitored at all times during the autorotation to assure a power recovery can be made at any time. Maintain an airspeed of 70 to 110 KIAS and N_r of 100 to 104% until approximately 150 feet above the surface. At approximately 150 feet above the surface, initiate a gradual flare by applying aft cyclic control and maintain N_r within limits throughout the maneuver by use of collective pitch. During the flare and prior to establishing a level attitude, the designated crewmember monitoring the throttles will smoothly advance both throttles to maximum. At approximately 30 feet above the surface establish a level flight attitude and increase collective pitch. Terminate all power recovery autorotations with less than 30 knots ground speed and at an altitude of approximately 15 feet AGL.

LANDING GEAR EMERGENCIES.

LANDING GEAR FAILURE.

Loss of utility hydraulic system pressure and/or loss of electrical power to the landing gear actuating valve may preclude normal landing gear extension or retraction. If a malfunction occurs, attempt to lower the landing gear, using an alternate method. Use the following procedures as conditions dictate:

a. Landing gear handle — "DOWN"
Place the landing gear handle in the DN position. When the uplock releases, enter a shallow dive and abruptly increase collective to use G force to attempt to pull the gear down.

CAUTION

If gear down sequence is accompanied by unusual noises or vibrations, gear should be visually checked by FE regardless of gear safe indication.

NOTE

The uplock pins must be pulled manually when the hydraulic uplock release malfunctions.

b. Alternate gear handle — "PULLED"

(1) With the landing gear handle in the DN position, regardless of the landing gear handle warning light indication, if the green main landing gear position lights do not indicate down and locked, pull the alternate gear extension handle to release high pressure air and fluid into the down portion of the actuating cylinder.

WARNING

After successfully completing an alternate gear extension, do not attempt any normal actuation of the system. However, if attempt to extend gear with alternate system fails and it is desired to actuate the normal system, push alternate gear handle down and reset the emergency release valves, located on the right side of the main transmission well, prior to resetting circuit breakers or operating the landing gear handle.

CAUTION

If the main gear position lights are flickering when the aircraft is on the ground, the alternate gear handle must be pulled prior to removing hydraulic power from the aircraft.

(2) If the landing gear warning system does not indicate down and locked after using the alternate gear extension, land the helicopter on mattresses using procedures contained in GROUND LANDING EMERGENCIES.

(3) A water landing may be made if facilities are available.

(4) At the discretion of the aircraft commander in the interest of flying safety, the flight engineer or ground personnel may be directed to install the ground lock pins while the helicopter is in a low hover.

WARNING

The helicopter should be statically grounded prior to installation of the pins to prevent possible injury to personnel making the installation.

CAUTION

After a landing gear malfunction or an unsafe landing gear condition, the aircraft will not be taxied or towed until it can be determined that the gear is down and locked and the gear pins are properly installed.

GROUND LANDING EMERGENCIES.

Landings with all wheels retracted or with any one or two wheels down may be made by placing soft objects, such as mattresses, under the bottom of the fuselage. With the objects in position the pilot will be directed to a vertical landing from a hover.

Landing With All Wheels Retracted.

Choose a level site with no obstructions and a soft surface such as sand, grass, or bushes. Let down slowly and smoothly with no forward or sideward motion. As the fuselage contacts the surface, reduce collective slowly and note which way the helicopter will tilt. Slowly reduce the throttles to GROUND IDLE and then to SHUTOFF. Maintain cyclic control as long as possible and gradually apply the rotor brake as control is lost.

Landing With Both Main Gears Retracted And The Nose Gear Down And Locked.

Attempt to retract the nose gear with the KNEELING switch to provide a symmetric configuration. If the nose gear cannot be retracted, use soft padding under the fuselage to minimize tilting during shutdown. Use the same technique as landing with all wheels retracted described elsewhere in this section. The helicopter will have a greater tendency to tilt with only the nose gear extended. The greatest damage will occur if the helicopter tilts to the left side as both the tail and main rotor blades may strike the ground.

Landing With Nose Gear Retracted.

A normal vertical landing from a hover should be accomplished at a location where the helicopter can be shut down. The aircraft should not be taxied with the nose gear retracted since the strut will not provide shock absorber action.

WARNING

Ensure that personnel remain clear of main rotor blades during landing and shutdown. The blade ground clearance in front of the helicopter is greatly reduced and may not provide man's height clearance.

NOTE

Pulling the nose gear and main gear circuit breakers may reposition the free trail valve which will enable the nose gear to lower.

EMERGENCY WATER LANDING PROCEDURES.

Planned Ditching.

Procedures and techniques required to accomplish emergency water landings are outlined in Sections II and III of this manual. However, should the situation develop where ditching becomes apparent, and if altitude permits, the following checklist should be accomplished in addition to the normal/emergency checklist:

1. Crew/Cabin occupants — ALERTED FOR DITCHING.
2. IFF — EMERGENCY.
3. Distress call — COMPLETED (give position report).
4. Tip tanks — AS REQUIRED.

NOTE

External auxiliary fuel tanks will provide additional stabilization and increase float capability while the helicopter is on the water. External auxiliary tanks will be retained with or without fuel during emergency water landings, except when in the aircraft commander's judgement, retention would further compromise safety.

5. Ramp — CLOSED.
6. Search and landing lights — AS REQUIRED.
7. Cockpit windows and personnel door — OPEN.

Immediate Egress.

If immediate evacuation is necessary upon water contact, engine/rotors should be shut down prior to personnel egressing from the helicopter. Survival equipment should be transferred to the raft(s) as personnel egress from the helicopter.

WARNING

Raft(s) and LPUs should not be inflated until clear of the helicopter to preclude fouling.

After Landing.

Following an emergency landing the crew should immediately determine if engine and rotor shutdown is required.

CAUTION

If an emergency water landing is due to complete loss of oil from the main transmission, limit APU operation to emergency requirements only.

If required, shutdown should be accomplished in accordance with Section II. Prior to rotor shutdown, consideration should be given to taxiing the aircraft to shore. If taxiing is not feasible, proceed with the AFTER LANDING and ENGINE/ROTOR SHUTDOWN CHECKLIST.

WARNING

During rotor shutdown, the rotor should be allowed to coast down to a stop. If blade to surface contact is probable, apply the rotor brake at as low an RPM as conditions will permit.

1. Landing gear — DOWN.
2. Anchor/Sea anchor — DEPLOYED.
3. Bilge pump — AS REQUIRED.

NOTE

Remove bilge covers to cabin and sponsons, and inspect for water accumulation. Pump out any water accumulation. Reinstall covers and panels when inspection has been completed or when bilge pump is not in use. Periodically inspect the water tight compartments for leakage.

Before Leaving the Helicopter.

If the decision is made to abandon the helicopter, accomplish the following items to aid in the recovery operation.

1. Bilge covers — SECURED.
2. Anchor lights — ON.
3. Windows and hatches — CLOSED.

SYSTEM EMERGENCIES.

This phase of operation covers emergencies that could occur as a result of system failure or malfunction.

FUEL SUPPLY SYSTEM FAILURE.

Engine Driven Fuel Pump Failure.

If the engine driven fuel pump should fail, the engine will shut down due to fuel starvation. Engine shutdown should be completed using normal or inflight shutdown procedures, as appropriate.

Boost Pump Failure.

If it has been determined that a boost pump has failed, turn boost pump switch to off position. If any or all of the boost pumps should fail, the engine driven fuel pumps will supply sufficient fuel for normal engine operation, provided the helicopter is not operated when a boost pump is required. Refer to EQUIPMENT LIMITATIONS in Section V. If a boost pump fails while operating in conditions requiring the use of boost pumps, turn the other boost pump on immediately to avoid possible engine flameout. Refer to GENERATOR FAILURE in this section for conditions where failure of all boost pumps and double engine flameout can occur.

Fuel Filter Bypass Caution Lights.

If a fuel filter bypass caution light should illuminate, ensure at least one boost pump per engine is on and land as soon as practical.

FUEL CONTROL SYSTEM FAILURE.

Power loss resulting from complete fuel control system failure can be determined by an immediate reference to the indication on the torquemeter, accompanied by a large decrease in power turbine inlet temperature (T_5), and further verified by a drop of power turbine speed. Engine stall is usually recognized by a rapid rise in T_5 and a decrease of N_g, accompanied by an audible rumble or vibration and a possible loud report or bang. Flameouts are recognized by an immediate decrease in T_5, N_g, fuel flow, torque, and N_f on the affected engine. If no engine malfunction was observed prior to the flameout, a restart may be attempted. It should be noted that the engine instruments often provide indications of fuel control system failure prior to actual engine failure. If engine failure is due to momentary malfunction of the fuel control system, or to improper operating technique, an air start can usually be accomplished to restore engine operation, when time and altitude permit. A malfunction of the normal fuel control system can be bypassed by use of the emergency fuel control lever.

The purpose of the emergency fuel control lever is to override the automatic feature of the engine fuel control. This is accomplished by a direct connection to the fuel metering valve of the engine fuel control. This direct connection to the fuel metering valve requires that the emergency fuel control lever be used with extreme caution to prevent overtemperature or overspeeding of the engine. The sensitivity of the emergency fuel control increases with high altitudes and/or high ambient temperatures. Engine response to emergency fuel control lever movement may occur at any point of lever travel, depending upon the position of the metering valve prior to moving the emergency fuel control lever. By positioning the throttle in the GRD IDLE position, nominal torquemeter readings equal to the properly operating engine can be maintained by use of the emergency fuel control lever.

WARNING

If the emergency fuel control lever is to be used, do not retard the throttle beyond the GRD IDLE position. Movement beyond the GRD IDLE position will cut off engine fuel supply regardless of the position of the emergency fuel control lever.

A constant flight attitude establishes optimum conditions that will allow the properly operating engine to absorb transient torque changes that occur with minor flight condition changes. The copilot can maintain balanced engine power through other flight conditions by manually adjusting the emergency fuel control lever of the affected engine to produce power equivalent to the properly operating engine. Engine instruments should be carefully monitored.

Failure of the Fuel Control Flex Shaft.

Failure of the fuel control to sense power turbine speed, due to flex shaft failure, will be apparent to the pilot when the N_f indicator for the affected engine drops to zero, at which time the N_g, T_5 and fuel flow will indicate maximum power. Torque on the affected engine will indicate power required based on the load on the rotor system.

The non-affected engine, sensing a lesser demand for power, will reduce fuel flow with a corresponding decrease in N_g, T_5, and torque. Corrective action for this condition is to maintain rotor (RPM) within limits using collective inputs. Once fuel control flex shaft failure has been positively identified, retard the throttle of the affected engine from the governing range to GRD IDLE, and utilize the emergency fuel control lever to meet power requirements.

WARNING

Impending engine bearing failure may reflect initial cockpit indications similar to those experienced during N_f flex shaft failure. Sudden engine vibrations accompanied by possible N_f fluxations may indicate imminent engine failure. This type of malfunction may lead to catastrophic failure of primary engine components, possibly resulting in an engine and/or cabin fire. Since complete engine drive failure may occur very rapidly, the engine should be shutdown as soon as possible to prevent further aircraft destructions. The decision to shut down the engine should be made based on factors including single engine capability, flight regime, etc.

NOTE

If flight conditions require the use of both engines, the emergency fuel control lever should be advanced prior to retarding the throttle from the governing range.

Failure of P3 Sensing.

Failure of P_3 sensing may cause the N_g to drop off either to or below ground idle speed with a corresponding drop in N_f and torque. Corrective action for this condition is to retard the throttle of the affected engine to GRD IDLE and utilize the emergency fuel control lever to meet power requirements. Closely monitor T_5 as use of the emergency fuel control at lowered N_g may result in overtemperature.

FUEL QUANTITY GAGE FAILURE.

If fuel consumption does not appear to be compatible with anticipated fuel consumption or the crew has reason to suspect an incorrect fuel quantity indication, depress the fuel quantity gage test switches. Switches should be held until pointers drop to below zero. After a drop to below zero has been noted, release test switches and pointers should return to their original readings. If the fuel quantity indications do not appear to be normal or the crew still suspects incorrect fuel quantity indications: Turn on all boost pumps, open the crossfeed valve, pull the affected fuel quantity indicator circuit breaker, compute estimated fuel on board, and land as soon as practical.

WARNING

Do not attempt to troubleshoot any fuel supply system or fuel quantity indicating system (i.e., exchanging fuel quantity indicators or resetting circuit breakers) as this may cause an explosion in the main fuel tanks.

ENGINE OIL SYSTEM MALFUNCTION.

Engine oil pump failure may be evidenced by loss of engine oil pressure and the N_g tachometer due to the fact that both the pump and tachometer are driven by the same shaft. If an oil system malfunction (as evidenced by high or low oil pressure or excessively low oil quantity) has caused prolonged oil starvation of engine bearings, the result will be a progressive bearing failure and subsequent engine seizure. Bearing failure will progress slowly until just prior to complete failure, then the rate of failure accelerates rapidly. The time interval from the moment of oil starvation to complete bearing failure depends on such factors as condition of the bearing prior to oil starvation, operating temperature of the bearings, and the bearing loads. A possibility exists for 10 to 30 minutes of operation after experiencing a complete loss of lubricating oil. Bearing failure due to oil starvation is generally characterized by a rapidly increased rate of vibration. When the rate of vibration increases from moderate to heavy, complete bearing failure is only seconds away and the affected engine should be shut down. Since the end result of oil starvation is engine seizure, the affected engine should be shut down immediately to preclude seizure, unless critical power requirements exist. If power is required from affected engine, any reduction or change of power should be held to a minimum. The affected engine should be shut down as soon as level flight on one engine can be maintained.

NOTE

- Avoid rapid and large variation in power settings. The minimum power established after malfunction is detected should be high enough to avoid the necessity for subsequent variations.
- If an ENG OIL LOW caution light should illuminate during extended flight, replenish supply from the auxiliary oil tanks.

ELECTRICAL SYSTEM FAILURES.

Alternating Current System Failure.

The bilateral alternating current system, powered by two ac generators, is so designed that failure of either generator will cause the nonessential bus, normally powered by the No. 2 generator, to be dropped from the system, and the operating generator to power the essential bus, normally powered by the No. 1 generator. However, the pilot's attitude indicator, powered by the No. 2 generator, is retained. If the No. 1 or No. 2 generator light illuminates, move the appropriate generator switch to the OFF/RESET position and return to the ON position. This will restore generator service if the malfunction was caused by momentary overvoltage. Malfunction of both generators does not mean a complete loss of ac power. The 100-volt ac inverter that is operated from the battery will furnish alternating current to the engine and transmission, oil pressure, hydraulic instruments, T_5 indicators, fire detector system, fuel quantity gages and torque sensors.

NOTE

Loss of both generators means that the battery is the only source of power available and, accordingly, all equipment not absolutely necessary should be turned off by pulling the applicable circuit breakers.

Generator Failure.

Failure of either or both generators will be indicated by the respective generator failure caution light.

WARNING

Impending mechanical failure of either generator may be accompanied by medium to high frequency vibrations without the associated generator caution light illuminated. Turning the generator off may reduce the severity of vibrations. Such generator failure can be a potential fire hazard.

Failure of One Generator.

1. No. 1 boost pumps — ON, if required.

2. Generator switch — OFF/RESET, then ON.

3. Generator switch — OFF, if power not restored.

NOTE

If respective generator is restored, the boost pump switches should be repositioned as required.

NOTE

Failure of either generator will cause the No. 2 transformer/rectifier and No. 2 FWD and AFT boost pumps to be inoperative.

WARNING

When operating the helicopter under conditions that require the use of fuel boost pumps, double-engine flameout and no subsequent start may be expected if all boost pumps become inoperative. Loss of all boost pumps can be expected under the following conditions:

a. One generator is inoperative and the other fails.

b. Both No. 1 boost pumps are inoperative and either of the generators fail.

Failure of Both Generators.

1. No. 1 generator switch — OFF/RESET, then ON.

2. No. 2 generator switch — OFF/RESET, then ON.

3. Generator switch(es) — OFF, if power is not restored.

NOTE

If both generators should fail, the battery will provide emergency power for approximately 15 minutes. However, as the battery voltage will hold constant until all charge is gone, decreasing voltage values will not be noted on the voltmeter. Available flight instruments are the pitot-static instruments, the standby compass, and the pilot's turn rate needle in the NORM position. It should be noted that TACAN, VOR, ADF, ILS, DOPPLER, J-4 COMPASS, IFF, ID-387, both pilot's ATTITUDE INDICATORS, AFCS, pilot's turn rate in ALT, copilot's turn rate in NORM, UHF/DF, and HF radio will be inoperative on dc electrical power. Communication and navigation needs will have to be determined by the pilot as the situation dictates.

4. If the No. 1 or No. 2 generator is not restored, turn off all unnecessary equipment, abort mission and land as soon as practical.

AC Essentiel Bus Failure.

Malfunction of the No. 1 supervisory panel can cause the ac essential bus to be dropped from the system.

Symptoms:

a. #1 XFMR RECT caution light On.

b. No. 1 fuel boost pump warning lights On (If fuel boost pump switch is on.)

c. Loss of AFCS.

d. Copilot's attitude indicator off flag displayed.

e. Blade press caution light on.

f. Loss of all other items on ac essential bus.

g. Loss of dc nonessential bus.

Corrective Action:

a. No. 2 fuel boost pump switches — ON, if required.

b. No. 1 generator switch — OFF. This causes the supervisory panel to allow the No. 2 generator to power the ac essential bus and to drop the ac nonessential bus from the system.

c. No. 1 fuel boost pump switches — ON, if required.

See notes and warnings in Failure of One Generator section.

Direct Current System Failure.

Direct current is supplied to the dc essential and nonessential buses from two transformer - rectifiers (T/R). The system is so designed that failure of either transformer - rectifier will cause the nonessential bus to be dropped from the system. Failure of either, or both, transformer - rectifiers will be indicated by lighting of the respective caution light, located on the caution panel. If both the No. 1 and No. 2 T/Rs fail, the nonessential bus will be dropped from the system, both T/R caution lights will be illuminated, and the essential bus will be powered by the battery only.

NOTE

> If the No. 1 T/R fails and either generator fails, both T/R caution lights will illuminate and the essential bus will be powered by the battery only.

UTILITY HYDRAULIC SYSTEM FAILURE.

The utility hydraulic system receives pressure from a pump driven by the accessory drive section of the main gear box. The landing gear, rescue hoist, and ramp systems will be inoperative in event of failure of the utility hydraulic pump, the accessory drive, or loss of hydraulic pressure in the system. On some helicopters, if a utility hydraulic system failure occurs, and there is no failure in the oil lines between the accumulator and the APU starter or the accumulator and the alternate nose gear actuator, the accumulator may be used either to start the APU or to lower the nose gear. If one of these systems has been used, it is necessary to recharge the accumulator before the other one can be activated. This may be accomplished either by normal charging by the utility pump, if the pressure lines have not failed, or by the use of the APU accumulator hand pump. Recharging of the accumulator utilizing the hand pump can be accomplished if the pump supply and discharge lines remain intact, and if sufficient hydraulic fluid remains in the system to charge the accumulator. The hand pump located in aft right hand cabin area provides the capability to recharge the accumulator in flight as well as on the ground.

FLIGHT CONTROL HYDRAULIC SERVO SYSTEM FAILURE.

Control of the helicopter can be maintained through either the primary or the auxiliary flight control system if one or the other is turned off or fails. Malfunctions of either servo system can result in erratic behavior of the helicopter, roughness, uncontrollable maneuvers, or locking of the controls. Therefore, it is of the utmost importance that crewmembers be able to quickly identify the malfunctioning system. When one servo system is lost or malfunctions, it should be shut off. Either system may be turned off by actuating the servo switch, provided there is at least 1000 psi hydraulic pressure in the remaining system. Prolonged operation on one servo system is not recommended; flight should be terminated as soon as possible due to the possibility of failure of the remaining servo system.

NOTE

> Once a malfunctioning servo has been identified and corrective action taken, an airspeed of approximately 70 KIAS will minimize the control forces.

SYMPTOMS OF HYDRAULIC SERVO SYSTEM MALFUNCTIONS.

Primary Servo Systems.

SYSTEM PRESSURE LOSS OR BLOCKED PRESSURE LINE.

Due to the spring-loaded bypass poppet valve, a loss of pressure causes an interconnection between both sides of the power piston. The servo then acts as a simple mechanical link between the auxiliary servo and the control rods to the rotor head. This type of malfunction can be recognized by a small amount of slop in the cyclic and the collective pitch controls and possible illumination of the primary servo pressure caution light.

HYDRAULIC HARDOVER.

This type of primary servo malfunction is identified by a vibratory load which will be felt in the fuselage and at the pilot's controls (cyclic and collective or cyclic only). The severity of the malfunction and the aerodynamic forces on the rotor blades will determine the amplitudes of the resulting vibratory load. This type of vibratory load differs from a similar vibration which may be caused by a malfunctioning AFCS. The hydraulic malfunction causes vibratory loads on the controls resulting in helicopter displacement, whereas an AFCS malfunction has no effect on the pilot's control, but may cause helicopter vibrations and/or helicopter displacement. Any vibrations caused by a malfunctioning AFCS would be eliminated by depressing the AFCS REL button or turning off the appropriate channel disengage switch.

BLOCKED RETURN LINE.

A return line that is completely blocked will restrain only motion of the affected servo in one direction because of the unbalanced piston in the primary servo. The result is a ratcheting motion of the cyclic stick (motion is possible in only one direction and irrecoverable in the other). The amount of control is dependent upon the amount of blockage. Anything other than a completely blocked return line will be controllable. In any event, placing the flight control servo switch in the PRI OFF position will alleviate the difficulty.

Auxiliary Servo System.

SYSTEM PRESSURE LOSS OR BLOCKED PRESSURE LINE.

Due to the spring-loaded bypass poppet valve, a loss of pressure causes an interconnection between both sides of the power piston. This type of malfunction can be recognized by a slightly heavier force required to move the cyclic stick, collective pitch lever, and the tail rotor pedals, possible illumination of the auxiliary servo pressure caution light, plus a loss of AFCS effectiveness.

HYDRAULIC HARDOVER.

An auxiliary servo hydraulic malfunction, such as control valve linkage failure, results in erratic or hardover control forces and is identified by extreme control pressures being felt in a single channel (either pitch, roll, collective or yaw channel). This is distinguished from an AFCS malfunction in that AFCS control authority is limited and easily overcome by the pilot, whereas an auxiliary servo is eliminated only by shutting off the auxiliary servo system.

WARNING

If erratic or hardover control forces occur, turn off the auxiliary servo system immediately to avoid abrupt attitude changes or altitude loss.

NOTE

One exception to the rule for coupled and uncoupled indications will be that a hardover in the fore and aft primary servo will overpower the auxiliary servo and drive the cyclic (longitudinal direction) to an extreme. At the same time, due to the action of the mixing unit, a force will be applied to the collective channel of the auxiliary servo. However, the force output of this channel is sufficient to withstand the applied force and the effect will not be felt at the collective. The end result is symptomatic of an auxiliary servo hardover but, in this case, is actually caused by a primary servo malfunction. If the pilot reacted to this situation by turning off the auxiliary servo, the collective stick would now be forceably moved along with the cyclic stick. The corrective action at this point would be to shut off the primary system.

BLOCKED RETURN LINE.

If closure of a return line from the auxiliary servo unit should occur, a hydraulic lock would form in all channels preventing control motion other than that allowed within the sloppy link. Approximately 2 1/2 to 3-inch displacement of the cyclic control is possible without changing the input to the rotorhead with a partially blocked return line. Because of the high degree of filtration and redundant porting in the servo valves, a block due to contamination is only a remote possibility. However, if blockage should occur, the problem can be alleviated by turning off the auxiliary servo system.

CORRECTIVE ACTION FOR SERVO MALFUNCTIONS.

The effects of any malfunctioning servo can be eliminated by use of the servo switch to shut off the system malfunctioning. An appropriate rule of thumb for determining which servo has malfunctioned is as follows:

a. If a single uncoupled force on collective pitch lever, cyclic stick, or rudder pedals is felt at the pilot's controls without vibrations, shut off the auxiliary servo system immediately.

b. If vibratory force, with or without a coupled indication, is felt in the flight controls, then turn off the primary servo system.

c. Land as soon as possible.

SERVO HYDRAULIC PRESSURE FAILURE.

Loss of pressure in either the primary or auxiliary servo systems will be indicated by either of the servo hydraulic low pressure caution lights and a lower than normal operating pressure on the corresponding servo hydraulic pressure gage.

WARNING

In the event hydraulic servo flight control system is lost or malfunctions, and the system is deactivated by the servo switch, loss of or intentional removing of all electrical power to the aircraft will cause the faulty servo to return to the on position regardless of the selected position.

1. Servo switch (affected system) — OFF. Land as soon as possible.

NOTE

- When AUX servo is OFF, the AFCS is ineffective.
- Because of the pressure switch interlock, it is impossible to turn off one servo system when the pressure in the other servo system is below 1000 psi.

MAIN ROTOR DAMPER MALFUNCTION.

Malfunction or failure of a rotor damper causes a dynamically unbalanced rotor condition which will be felt as a low frequency lateral or vertical vibration. The magnitude of the vibration is dependent on the severity of the malfunction and the flight condition. The effects of turbulence will increase the magnitude of the vibration similar to the effects of maneuvering and will be dependent on the degree of turbulence and flight conditions. Rotor blades will normally stay in track. It is recommended that a landing be made as soon as practical since the vibration may affect other systems and components. A shallow approach to a running landing is preferable; but, if conditions do not permit, then a normal approach to a touchdown should be made with a minimum of time spent in hover. If a rotor damper is suspected of malfunctioning, proceed as follows:

a. Airspeed — Adjust to minimize vibration.

NOTE

Maintain normal rotor speed (100 - 103% N_r). Make small, smooth control inputs and shallow turns.

b. Land as soon as practical.

c. Engine and rotor — Shut down without using rotor brake.

WARNING

- Do not increase collective or use rotor brake as this will increase the possibility of blade-to-blade contact.
- Ensure that all personnel are clear of rotor system prior to engine shutdown.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS).

POWER SUPPLY FAILURE.

The AFCS will become inoperative in the event of failure of the auxiliary servo system, both generators, or all dc power.

AFCS Malfunction.

a. In the event that AFCS signals cause the helicopter to oscillate in pitch or roll, or if it is necessary to fly with the cyclic stick displaced from its normal position and this condition is reflected by either the vertical or horizontal bars on the AFCS indicator, switch gryros by use of gyro select switch on the channel monitor panel.

NOTE

Switching gyros may result in a momentary abrupt change of attitude while the AFCS transitions to the gyro giving the correct information. These changes are caused by the AFCS plus the pilot's correction overriding the AFCS at the time the gyros are switched. If possible the copilot shall monitor the flight controls while the pilot switches gyros.

b. If oscillations or unusual forces are encountered in the collective pitch lever, depress the BAR REL button on the AFCS control panel.

c. If the action described in steps a. and b. fails to eliminate the difficulty or unusual forces are encountered in the pedals or cyclic control, turn off the appropriate channel by use of the channel disengage switch on the channel monitor panel.

d. If the trouble persists or is such that immediate action is deemed necessary, depress the AFCS REL button on either the pilot's or copilot's cyclic stick.

e. Since the authority of AFCS in all channels is limited to a fraction of total control travel, any emergency override in case of malfunction may normally be achieved by introducing a control correction. However, if a malfunction is not corrected by step a. through d., the AFCS may be entirely eliminated from the flight control system by turning off the auxiliary servo.

NOTE

Certain AFCS electronic malfunctions can cause severe vibrations and noise throughout the airframe by applying erratic signals to the auxiliary servo valves. Disengagement of the AFCS will identify this problem.

AFCS HARDOVERS.

a. A hardover in the AFCS pitch or roll channels will be indicated by the following:

(1) Displacement from selected pitch or roll attitude with no corresponding movement of cyclic.

(2) Displacement can easily be overridden by pilot.

(3) Vertical or horizontal bars on the AFCS indicator will show full scale deflection.

b. A hardover in the AFCS collective or yaw channels will be indicated by the following:

(1) Aircraft is displaced from desired heading with corresponding movement in tail rotor pedal or from desired altitude with corresponding movement of collective.

(2) The displacement can easily be overridden by the pilot.

(3) Vertical or horizontal pointers on AFCS indicators will show full scale deflection.

c. Should an AFCS hardover in any channel occur, the following corrective action should be taken:

(1) Override the AFCS input to regain aircraft control.

(2) Analyze AFCS indicator to determine the defective channel.

(3) Pass control of aircraft to copilot.

(4) Disengage the defective channel on the AFCS channel monitor panel.

d. If the hardover condition still exists, the entire AFCS should be disengaged from the flight control system by depressing the AFCS release button on the pilot's or copilot's cyclic. If this does not eliminate the hardover, the AFCS can be entirely eliminated by turning off the auxiliary servo.

MAIN GEAR BOX FAILURE.

Failure of the main gear box may be indicated by illumination of the chip detector caution light and/or the main gear box chip location light on the chip location panel, or by abnormal transmission temperature or pressure indications. The chip detector light indicates the presence of metallic chips in the transmission oil system which is a sign of unusual wear. Carefully monitor transmission oil pressure and temperature and land as soon as practical. The flight may be continued, if necessary to reach a safe landing area, but unnecessary delay in landing should be avoided.

WARNING

If the main gear box oil temperature indicator reads more than 145°C, it indicates either a malfunction in the main gear box or the oil cooling system. The main gear box may not be receiving proper lubrication or may be running hot due to overservicing.

LOSS OF PRIMARY OR SECONDARY MAIN GEAR BOX OIL PUMP.

Loss of the primary or secondary oil pump will be indicated by a decrease in transmission oil pressure to the precautionary operating range (yellow arc). Primary pump failure may further be indicated by loss of the torque indicating system. Secondary pump failure may be accompanied by the loss of the utility hydraulic pressure system. In the event of a primary or secondary oil pump failure, land as soon as practical.

LOSS OF MAIN GEAR BOX OIL SUPPLY.

A break in the primary lubricating system could result in loss of the oil contained in the main gear box with the exception of the oil remaining in the emergency sump. When only the 1.5 gallon emergency sump oil supply remains in the transmission, flight should be limited to 30 minutes with landing accomplished as soon as practical. The torquemeter readings will decrease and fluctuate when oil is being diverted to lubricate the input sleeve bearings (possibly momentarily indicating zero).

WARNING

- Damage to the bottom of the transmission or torque system oil pump could result in the loss of the emergency sump oil supply, as indicated by no transmission oil pressure indications and a complete loss of torquemeter reading (zero torque on both indicators). This situation requires an immediate autorotation. A power on landing may not be possible.

- If torque indications decrease to zero when flying with only the emergency sump oil supply remaining, enter an immediate autorotative descent to reduce the load on the sleeve bearings. The landing, either full autorotation or power on, must be determined by the pilot based on the existing conditions.

NOTE

If reducing power does not lower the temperature to 145°C or below, refer to MAIN GEAR BOX MALFUNCTION in this section.

MAIN GEAR BOX MALFUNCTION.

Symptoms:

Any one of the following conditions:

1. TRANS OIL PRESS caution light on.
2. TRANS OIL HOT caution light on.
3. MAIN CHIP light on.
4. Main gear box oil temperature indicator at red line.
5. Main gear box oil pressure indicator at red line.
6. An indication of no transmission oil pressure (12 psi or less).
7. Abnormal transmission noises.
8. Yaw kicks accompanied by fluctuations in both torquemeters.

Corrective Action:

1. Land as soon as practical.
2. AFCS yaw channel — OFF (with yaw kicks).
3. Monitor engine and transmission instruments, caution panel and torque indications.

4. Fly at minimum safe autorotation altitude.

5. Cruise between 70 and 100 KIAS.

6. Jettison unnecessary fuel and equipment.

7. Avoid high power maneuvers.

When gear box temperatures are between 135°C and 145°C monitor other instruments and land as soon as practical. Time duration will be entered in the Form 781. When the gear box is operated between 135 and 145°C for one hour or temperature exceeds 145°C, land as soon as possible and enter remarks concerning the degree to which the limits were exceeded and the time duration in the Form 781. Anytime gear box temperature exceeds 135°C, the aircraft will not be flown again until cleared by qualified maintenance personnel.

CAUTION

Flight with no indication of transmission oil pressure (12 psi or less) can be sustained for approximately 30 minutes.

IMMINENT FAILURE OF THE MAIN GEAR BOX.

Symptoms:

1. An indication of no transmission oil pressure and:

   a. Both torque needles at zero.

   b. Yaw kicks.

   c. Unusually high power requirements.

   d. A rapid N_g/T_5 rise.

   e. Abnormal transmission noises.

   f. Transmission temperature caution light on.

   g. Transmission temperature indicator at red line.

NOTE

When operating on oil from the emergency supply system, the transmission oil temperature indicators (caution light and gauge) may not be a reliable indication of MGB temperature.

   h. MAIN CHIP light on.

2. MAIN CHIP light on and:

   a. Yaw kicks.

   b. Unusually high power requirements.

   c. Abnormal transmission noises.

Corrective Action:

Enter an immediate autorotative descent to reduce the load on the sleeve bearings. The landing, either full autorotation or power-on, must be determined by the pilot based on existing conditions.

ROTOR SHUTDOWN WITH AN INOPERATIVE ROTOR BRAKE.

a. Head aircraft into wind if winds exceed 10 knots.

b. APU — ON.

c. Cyclic — NEUTRAL. Maintain this position until rotor blades have come to a stop.

WARNING

Excessive blade flapping may cause blade to fuselage contact. Egress from aircraft should not be attempted until rotor blades have come to a stop.

SHUTDOWN WITH TAIL TAKEOFF FREE WHEEL UNIT INOPERATIVE.

If tail takeoff freewheel has failed and the APU is inoperative, the following procedures will ensure servo hydraulic pressure is available until rotor is shut down.

1. Pins and chocks — IN.
2. Throttles — GROUND IDLE.
3. Droop stops — IN.
4. No. 2 engine — SHUTDOWN.
5. Rotor brake — ON (45% N_r or less).
6. No. 1 engine — SHUTDOWN.
7. Continue with Engine Shutdown checklist.

EMERGENCY ENTRANCES AND EXITS.

PILOT'S COMPARTMENT SLIDING WINDOWS.

The pilot's compartment sliding windows, one located on each side of the pilot's compartment, are normally opened and closed by actuating the handle, located on the lower forward edge of the window. The windows may be opened to any detent position when the handle is released. The windows can be jettisoned from the outside by the release lever, marked EXIT RELEASE-PRESS BUTTON-TURN HANDLE-PULL-OUT WINDOW. The release lever is pushed in on one end, which causes the handle to extend outward, and the handle is then turned downward to release the window assembly. After the window has been released, it will have to be pulled out. The window can also be jettisoned from the inside by rotating the window emergency release handle upward and pushing out the window from the bottom.

CARGO COMPARTMENT WINDOWS.

Jettisonable windows located on the left front side of the cargo compartment and over each sponson provide ground access to the outer fuselage and sponsons from inside the cabin to facilitate bilge pump operations, maintenance, and docking during water operations. The windows may be removed from the outside by pulling down on the outside release lever and pulling the window out. The windows may be jettisoned from the inside by rotating the release lever forward and pushing the window out. On aircraft modified for armament, use the forward (red) release lever to jettison the left forward window.

WARNING

Prior to removing the left jettison window for access to the left sponsons, ensure the HF-130 radio is off. The HF antenna emits high voltage radiation during HF transmission.

The cargo compartment windows forward and aft of the sponsons are permanently installed and are not designed as emergency exits.

PERSONNEL DOOR EMERGENCY ENTRANCE.

The personnel door is normally opened and closed by the handle, marked TO OPEN, TURN AND PUSH, with arrows pointing direction to turn and push, located on the outside of the door. Outside the personnel door, below the window, is marked CUT HERE FOR EMERGENCY RESCUE.

RAMP.

The ramp may be lowered from the outside by pulling a handle, located below the tail pylon under a cover, marked RAMP EXIT RELEASE HANDLE INSIDE COVER. When the handle is pulled, the ramp hydraulic cylinder moves to the open position and the aft ramp uplocks unlock. The ramp will then open by its own weight, permitting entrance to the cargo compartment. The ramp may be lowered mechanically from the inside by pulling forward on the AFT RAMP RELEASE HANDLE located above the forward ramp on the right-hand side of the cargo cabin.

WEAPONS SYSTEMS EMERGENCIES.

M60 MACHINE GUN.

Emergency Aircrew Procedures.

The following descriptive and procedural material is provided for the performance of emergency aircrew procedures from the time the aircrew reports to the loaded aircraft until after landing.

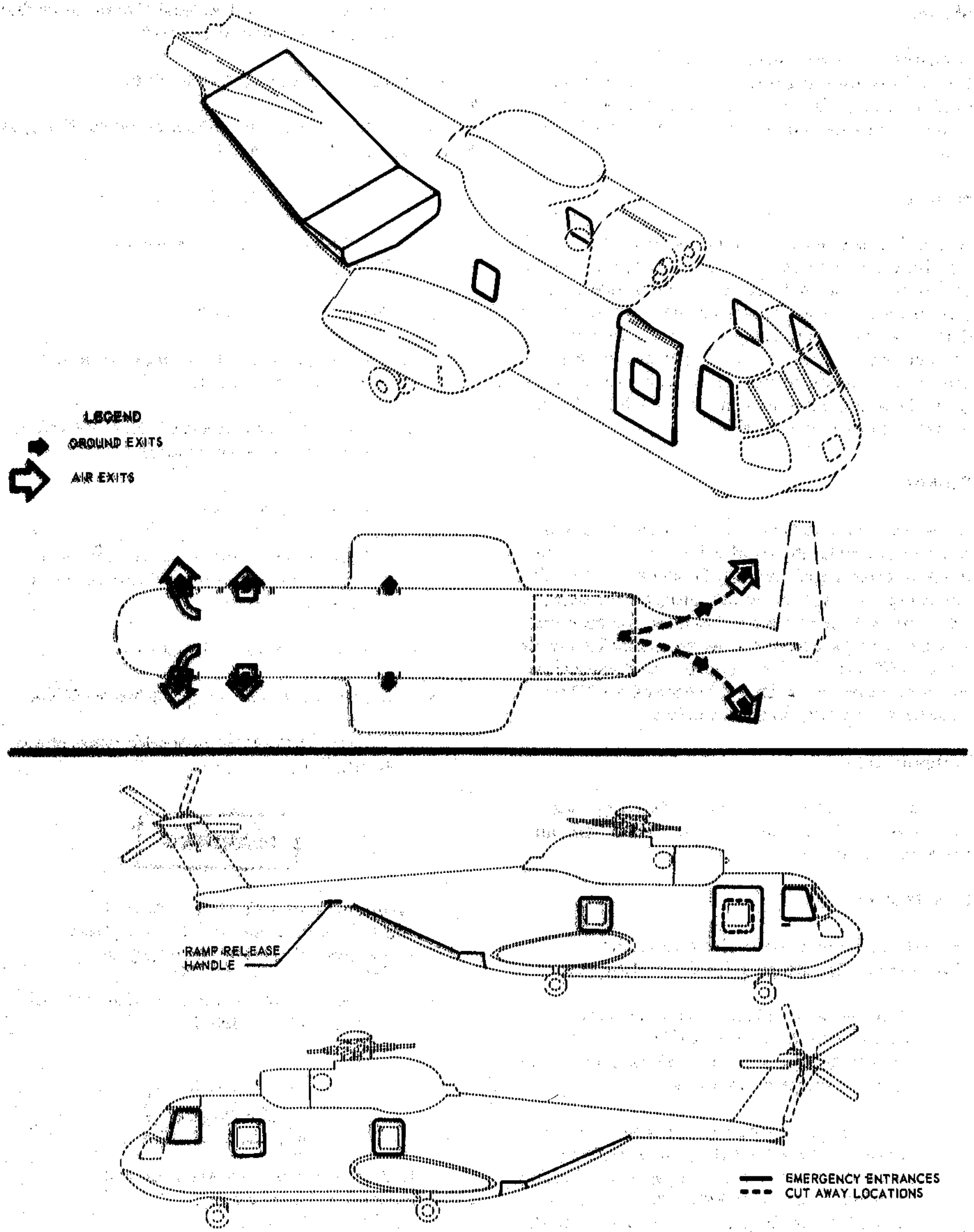


Figure 3-6. Emergency Entrances and Routes of Escape and Exits

Misfire.

A misfire is the complete failure of the weapon to fire. This is not dangerous but must be treated as a malfunction in the firing mechanism or a faulty round. A misfire should not be confused with a hang fire.

Hangfire.

A hangfire is a delay in the function of the propelling charge. The amount of delay is unpredictable, but in most cases will fall within the range of a split second to several seconds. Hangfire cannot be distinguished immediately from a misfire and therein lies the principal danger of assuming a failure of the weapon to fire immediately upon actuation of the firing mechanism as a misfire, whereas, it may prove to be a hangfire.

Cookoff.

A cookoff is the firing of the explosive components of a round due to the overheated chamber of the weapon (after approximately 30 seconds of continuous firing) and not to the actuating of the firing mechanism. When a cookoff occurs, the projectile may be propelled from the weapon with its normal velocity. If a cookoff is suspected, and round has not been extracted within 10 seconds, wait five minutes before the bolt is retracted.

Runaway Gun.

If the gun continues to fire after the trigger has been released, immediately break ammo links and allow gun to empty.

Time Interval.

The definite time intervals for waiting after failure of weapon to fire are prescribed as follows:

1. Keep round locked in chamber for five seconds from the time a misfire occurs to ensure against an explosion outside of the gun if a hangfire develops.

2. If the barrel is hot and a misfire stops automatic operation of the gun, wait five seconds with the round locked in the chamber to ensure against hangfire dangers. If the round cannot be extracted within an additional ten seconds, it must remain locked in the chamber for at least five minutes due to the possibility of cookoff.

Procedures in Case of Failure to Fire.

After a failure to fire, the following precautions, as applicable, will be observed.

NOTE

Keep pilots informed of all weapon malfunctions.

1. Guns — ON TARGET.
   a. Keep gun trained on target for a minimum of five seconds.
   b. Expended brass chute — Remove (Gain access to cocking handle).
2. Cocking handle — AFT.
   a. Pull cocking handle aft to attempt to eject round. Return cocking handle to forward position.
   b. Safety Button — S (Safety).
3. If round is ejected — RESUME FIRING.

   Resume firing after expended brass chute is installed.

WARNING

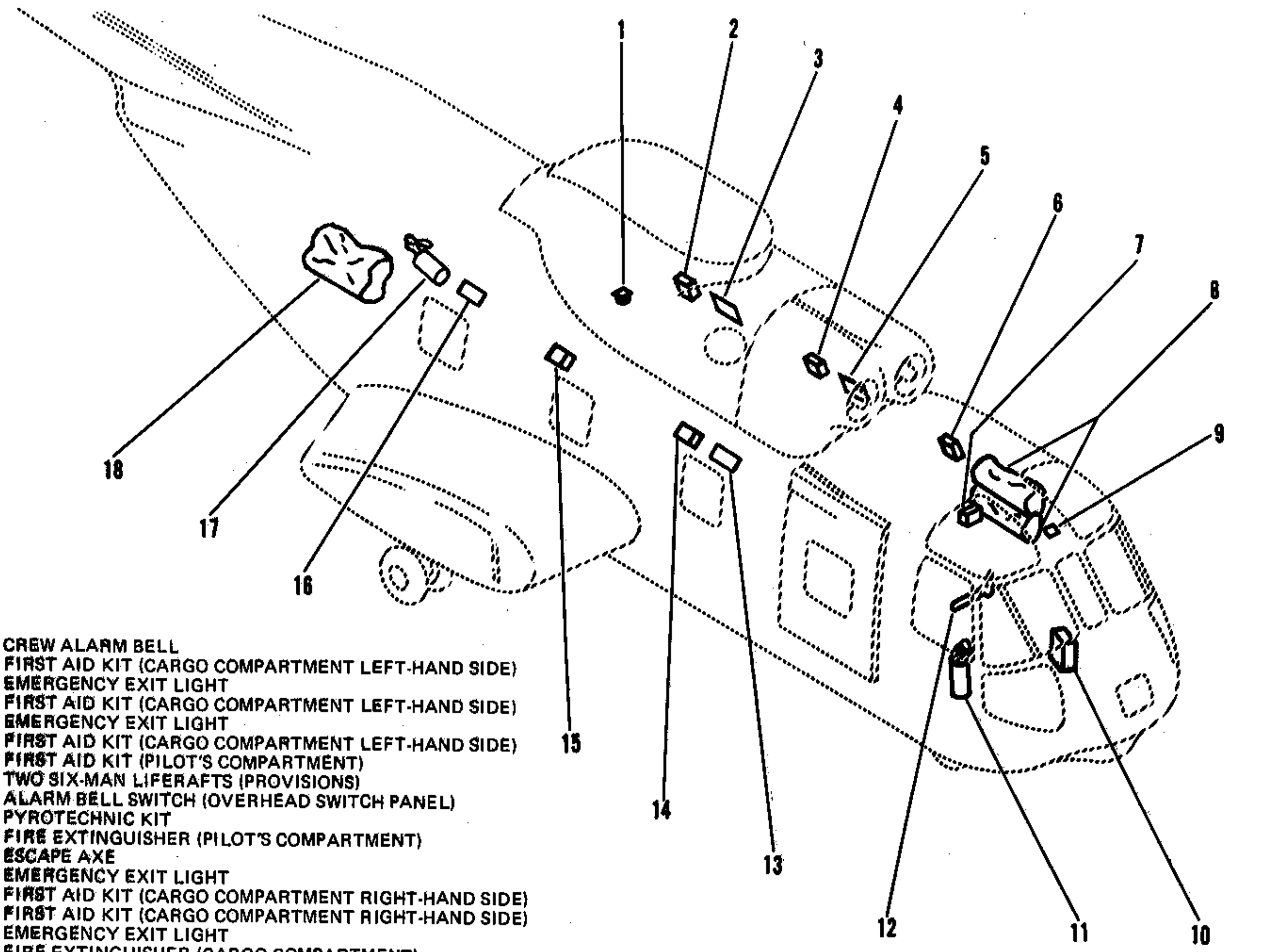
Weapons fired without the expended brass chute installed will cause damage to the aircraft's rotor blade system.

4. If round is not ejected — RAISE COVER AND REMOVE BELT.

WARNING

If the round does not eject, do not attempt to fire the gun.

5. Chamber — CLEAR.



1. CREW ALARM BELL
2. FIRST AID KIT (CARGO COMPARTMENT LEFT-HAND SIDE)
3. EMERGENCY EXIT LIGHT
4. FIRST AID KIT (CARGO COMPARTMENT LEFT-HAND SIDE)
5. EMERGENCY EXIT LIGHT
6. FIRST AID KIT (CARGO COMPARTMENT LEFT-HAND SIDE)
7. FIRST AID KIT (PILOT'S COMPARTMENT)
8. TWO SIX-MAN LIFERAFTS (PROVISIONS)
9. ALARM BELL SWITCH (OVERHEAD SWITCH PANEL)
10. PYROTECHNIC KIT
11. FIRE EXTINGUISHER (PILOT'S COMPARTMENT)
12. ESCAPE AXE
13. EMERGENCY EXIT LIGHT
14. FIRST AID KIT (CARGO COMPARTMENT RIGHT-HAND SIDE)
15. FIRST AID KIT (CARGO COMPARTMENT RIGHT-HAND SIDE)
16. EMERGENCY EXIT LIGHT
17. FIRE EXTINGUISHER (CARGO COMPARTMENT)
18. ONE TWENTY-MAN LIFERAFT (ABOVE RAMP) (PROVISIONS)

Figure 3-7. Emergency Equipment

6. Gun — REARM.

AN/ALE-20 FLARE EJECTOR SET.

Flare Case Fire (Ground Operations).

1. Evacuate personnel.

2. Notify firefighting unit.

Flare Case Fire (In Flight).

1. RH or LH case jettison switch — ON. If flare case fails to jettison:

2. Manual Case Jettison Lever — PULL.