ERA22FA279

OPERATIONAL FACTORS

Group Chair's Factual Report – Attachment 8

Army UH-1B Technical Manual Excerpts

November 2, 2022

CHAPTER 3
NORMAL PROCEDURES

Section I — Scope

3-1. Purpose. Chapter 3 contains instructions and procedures covering flight of the helicopter from the planning stage through actual flight considerations to securing the helicopter after landing. Normal and standard conditions are assumed in these procedures. Pertinent data in other chapters is referenced when applicable.

3-2. Normal procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist Technical Manual TM 55-1520-211-10CL.

3-2A. The instructions and procedures contained herein are written for the purpose of standardization and are not applicable to all field situations.

Section II — Flight Procedures

3-3. Preparation For Flight. This period should be devoted to matters of general mission planning and a study of special problems involved in operating the aircraft for mission completion.

3-4. Flight Restrictions. Refer to chapter 7 of this Technical Manual for flight restrictions due to helicopter operating limitations.

3-5. Flight Planning. The safe and efficient planning of the mission to be accomplished will provide the pilot with the data to be used during flight. The information to be used can be compiled from the following sources.

a. Check type of mission to be performed, and destination.

b. Select performance charts to be used from Chapter 14..

c. Record for in-flight use, the information concerning fuel quantity required, airspeed, power settings, take-off, climb, cruise or hovering condition, landing and fuel consumption for operating gross weight and climatic condition.

d. When the aircraft is flown by the same flight crew during tactical or administrative missions requiring intermediate stops, the flight crew need not perform all the pre-flight checks required by the amplified or condensed checklists for beginning flights. Under these conditions, only the starred (*) items in these lists are required checks to assure safe operation.

3-6. Take-Off and Landing Data Cards. Take-off and landing data cards in format for local reproduction are contained in TM 55-1520-211-10CL. Consult chapter 14, Performance Data, for detailed operating information when planning various types of missions that require use of the data cards.

3-7. Weight And Balance. Ascertain proper weight and balance of the helicopter as follows:

a. Consult applicable weight and balance instructions given in Chapter 12, and ascertain that DD Form 365F has been completed properly.

b. Compute take-off and anticipated landing gross weight, checking helicopter CG and location and ascertaining weight of fuel, oil, payload, etc.

c. Check that loading limitations, described in Chapter 7, have not been exceeded.

3-8. Pre-Flight Check. The amplified preflight check includes the exterior and interior checks as outlined.

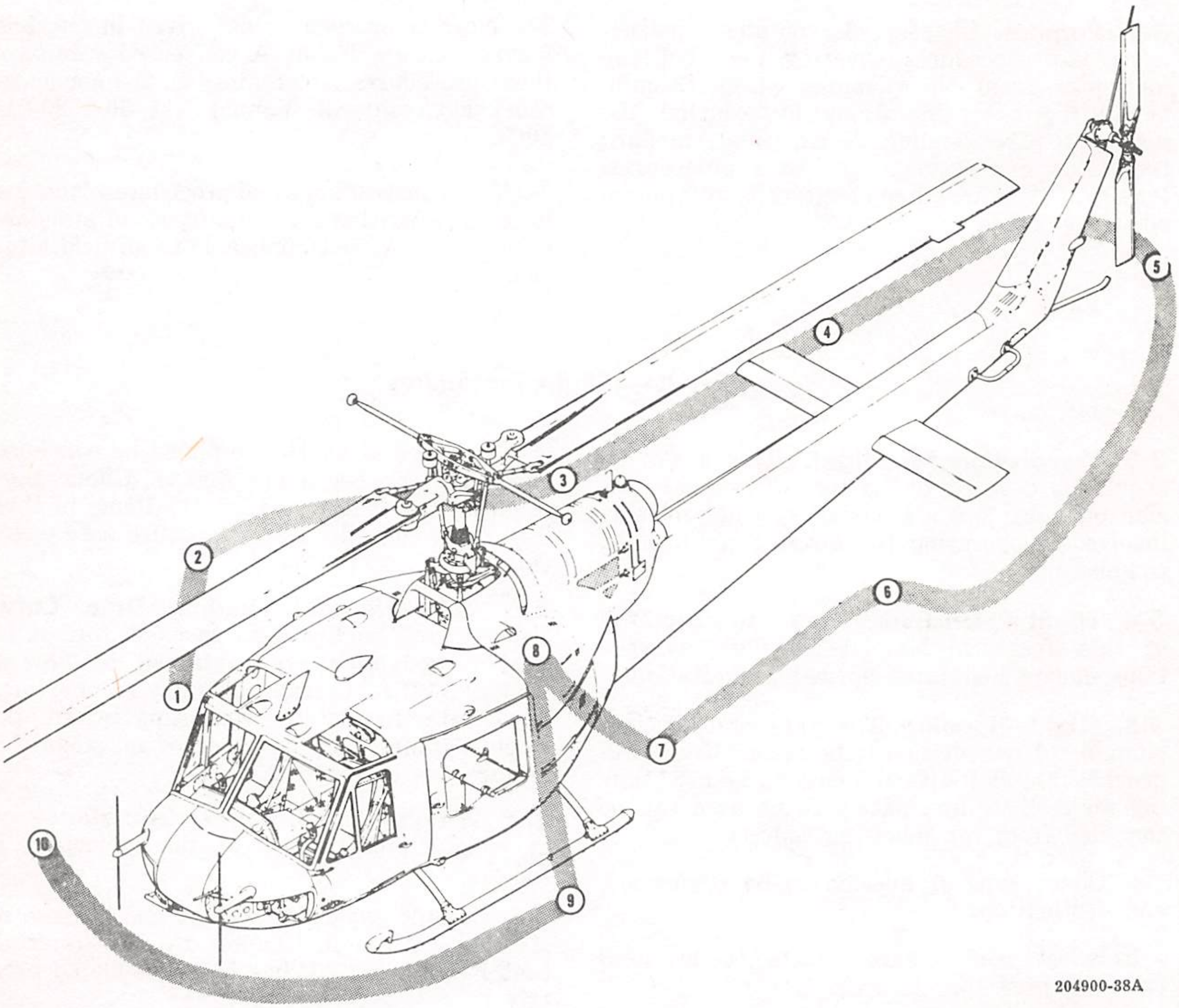

Figure 3–1. Exterior check diagram

3-9. Before Exterior Check. Check fuel and oil servicing data requirements as given in Chapter 2.

a. Check DA Forms 2408.

*b. Check battery switch — OFF.

3-10. Exterior Check. The designated exterior check areas are shown in figure 3-1. The following checks reference these areas.

Note

Be certain that helicopter is clear of all obstructions, including other aircraft.

3-11. *Fuselage Front—Area 1.* Pilots door—window and door set properly on hinges.

3-12. *Fuselage — Cabin Right Side Area 2.* a. Check condition and cleanliness of glass and operation of entrance doors.

b. Check condition of landing gear and remove handling wheels.

c. Check security of cargo suspension unit.

d. [A] Drain right sump.

[B] Drain right sump and right pump.

[540] Drain hydraulic system No. 1 collective accumulator, then check that accumulator gage needle indicates in green area.

e. Check condition of navigation lights.

f. Check rescue hoist for proper storage (if installed).

3-13. *Fuselage — Aft of Cabin Right Side Area 3.*

a. Deleted.

*b. Check hydraulic fluid level.

*c. Check security of engine and transmission cowling.

*d. Visually check fuel level, secure filler cap (except [540]).

e. Visually check engine oil level and secure filler cap.

*f. Visually check transmission oil level.

*g. Secure access doors.

*h. [540] Check accumulator bottle for proper charge.

i. Visually check external surfaces and ground beneath engine compartment for oil leaks.

j. Check that exhaust pipe cover is removed and pipe clear of obstructions.

3-14. *Aft Fuselage (Tail Boom) — Right Side Area 4.* a. Check cleanliness and general condition of aft fuselage.

b. Check condition of synchronized elevator.

c. Check security and condition of omni antenna.

*d. Visually check oil level 42° tail rotor gear box.

e. [540] Check condition of navigation light(s).

*f. Visually check aft rotor blade for condition and cleanliness.

3-15. *Fuselage Full Aft — Area 5.* a. Check tail skid condition.

b. Check navigation lights.

c. Check aft fuselage extension cover hinge for security.

*d. Visually check oil level in 90° tail rotor gear box.

*e. Remove tail rotor blade tie-down and check tail rotor for condition and free movement on flapping axis.

*f. Secure aft fuselage extension covers.

*g. Remove main rotor blade tie-down.

3-16. *Aft Fuselage — Left Side Area 6.* a. Check security of tail rotor drive shaft covers.

b. Check condition of synchronized elevator.

c. Check security and condition of omni antenna.

*d. Check aft fuselage for cleanliness and general condition.

3-17. *Fuselage — Aft of Cabin Left Side Area 7.* a. Check security of engine and transmission cowling.

*b. **5 4 0** Visually check fuel level, secure filler cap.

c. Check that battery is connected and circuit breakers in.

d. Check vent lines to be clean and unobstructed.

e. Secure access doors.

f. **A** Drain fuel pump and sump.

B Drain fuel sump, pump, and fuel filters.

3-17A. *Cabin Top — Area 8.* a. Check main rotor system for condition, cleanliness and security; check level of damper oil, blade grip, and pillow block reservoirs.

b. Check engine short shaft for condition and security.

*c. Check that engine air intake cover is removed and intake is clean, and free from obstruction.

d. Check that engine and transmission cowling is secured.

e. Check anti-collision light for security and condition.

f. Check that cabin top ventilators are unobstructed.

g. Check antennas for condition and security.

3-18. *Fuselage — Cabin Left Side Area 9.* a. Check condition of landing gear, remove handling wheels.

b. Check that landing light is stowed.

c. Check condition of navigation lights.

d. Secure access doors.

e. Check entrance doors for condition, cleanliness, and operation.

Warning

Inspect quick-disconnect fitting on main fuel line at fuel filter for security by insuring that a positive lock has been accomplished. Inspect security by noting lock-pin indicators.

3-18A. *Fuselage Front — Area 10.* a. Visually check condition and cleanliness of front rotor blade.

b. Visually inspect static ports.

5 4 0 Check that static port right is clean and clear of obstruction.

5 4 0 Visually inspect pitot tube to be uncovered and clean.

c. Check security of radio door.

d. Check security and condition of antennas.

e. Inspect pitot tube to be uncovered and clean.

f. Inspect cabin area for defects and glass cleanliness.

g. Check that searchlight is stowed.

h. Check that cargo suspension mirror (if installed) is secured and covered (uncovered and adjusted if external cargo is anticipated).

Note

For night flights check operation of all exterior lights.

3-19. Interior Check. After exterior check, accomplish the following:

a. Dome lights — Check for operation.

b. First-aid kit — Secure.

c. Cargo — Check for proper loading and tiedown.

d. Passenger seats — Check security of installation.

e. Crew member radio panel — Check ON INTercom and HOT MIC position of selector switch.

f. Rotor blade tie-down — pitot cover, intake cover, tail pipe cover, and all loose equipment stowed.

g. Fire extinguisher — charged and secured.

*h. Entrance doors — secured for flight.

3-19A. Before Starting Engine.

*a. Seat and pedals — ADJUSTED.

*b. Safety belt and shoulder harness — FASTEN.

c. Operation of shoulder harness lock — Check operation and leave unlocked.

d. Cyclic and collective — UNLOCKED.

*e. Cyclic, collective pitch, and pedals — Actuate through full travel and center. (Not applicable to 5 4 0.)

f. AC Circuit Breaker Panel: Circuit Breaker — IN.

g. Collective pitch control head—All switches off.

h. Engine Control Panel:

(1) Fuel Start and main — OFF.

(2) Oil Valve — OPEN.

(3) Hot air valve — CLOSED.

(4) Transfer Pump — OFF.

(5) Governor — AUTO.

(6) Low RPM Audio — OFF.

i. Communications Group:

(1) Pedestal panel right side — all communication systems — OFF.

(2) Pedestal panel left side — all communication systems — OFF.

j. DC Circuit Breaker — IN (except for armament and special equipment).

k. Dome lights and pitot heater control panel — Dome lights as required; pitot heater off.

l. Exterior light control panel — Navigation lights as required; anti-collision light off.

m. Miscellaneous Control Panel:

(1) Wipers — OFF.

(2) Cargo release — OFF.

n. Cabin heater control panels — All selectors off or normal.

o. Instrument lights control panel — as desired.

p. AC Power Control Panel:

(1) VM—AC phase.

(2) Invtr — Spare — ON (OFF for battery start).

q. DC Power Control Panel:

(1) VM—MAIN GEN (BAT for battery starts).

(2) MAIN GEN — ON (Safety cover closed).

(3) Battery — OFF (ON for battery start).

(4) Starter-Gen — START.

(5) NON-ESS BUS — NORMAL ON.

r. Outside Air Temperature Gage — Check temperature.

s. Co-pilot Instrument Group — Instruments — Check static indications, slippage marks, and operating range limits.

(1) Airspeed.

(2) J-8 Attitude Indicator — Cage (Omit for battery start).

(3) Altimeter — Field Elevation — SET.

(4) Induction (Magnetic) Compass Indicator — Aligned with standby compass.

(5) Vertical velocity indicator.

t. Engine Systems Group:

(1) STBY GEN Loadmeter — Static reading.

(2) AC Voltmeter — Static reading.

(3) MAIN GEN Loadmeter — Static reading.

(4) DC Voltmeter — Static reading.

(5) TRANS OIL Temperature Indicator — Note indication.

(6) ENGINE OIL Temperature Indicator — Note indication.

(7) Fuel Pressure Indicator — Note indication (Battery start — Omit.)

(8) Fuel Quantity Indicator — Note indication (Battery start — Omit.)

(9) FUEL GAGE TEST BUTTON — Push and hold 200 pounds drop — Release. (Battery start — Omit.)

u. Warning Group:

(1) Chip Detector Warning Light — Press to check.

(2) Master Caution Light — Check — ON.

(3) RPM Warning Light — Check — ON.

(4) FIRE DETECTOR TEST Button — Push — Check fire warning light — ON.

v. Pilot Instrument Group:

(1) Dual Tachometer — Check indication.

(2) TORQUEMETER — Check indication.

(3) GAS PRODUCER Tachometer — Check indication.

(4) Airspeed — Indication.

(5) Altimeter — Field elevation.

(6) Radio (Magnetic) Compass Indicator — Aligned with standby compass.

(7) Vertical Velocity Indicator — Indication.

(8) Standby Compass and Card — Free — Up to date.

(9) Clock — Wound-Running.

(10) MARKER BEACON SENSING Switch — OFF.

(11) OMNI Indicator — Check course selector free.

(12) Turn-and-Slip Indicator — Free of bubbles. Needle and ball centered.

(13) Exhaust Gas Temperature Indicator — Static.

(14) Compass Slaving Switch — IN or MAG HDG.

w. Caution Panel:

(1) Test and Reset.

(2) Bright-Dim Selector — As desired.

x. Hydraulic Control Panel:

(1) FORCE TRIM — ON.

(2) HYD CONTROL — ON.

y. Engine Control Panel:

(1) FUEL START — ON.

(2) FUEL MAIN — ON.

z. Throttle:

(1) Check through full travel and return to FLIGHT IDLE (Increase side of engine idle stop).

(2) Check operation of engine idle stop, then move throttle to decrease side of the idle stop.

Caution

During an unassisted battery start, the throttle must be positioned between the engine idle stop and the off position. Electrical power necessary to release the stop may not be available due to high battery drain during engine-starter operation.

3-20. Starting Engine. After interior check proceed as follows:

a. Fire Guard—POSTED.

b. Check Rotor Blades—CLEAR.

c. Energize Starter and Start Clock (Start fuel flow and ignition occur simultaneously).

Caution

Check DC Voltmeter, if voltage drops below 14 volts, abort start.

Caution

Limit starter energize time to 40 seconds. If engine does not start, a three minute cooling period is recommended after which a second starting cycle may be attempted. Only three forty-second starting attempts are permissible in any one hour period.

d. Start Fuel Switch—OFF at 400°C (if installed).

Caution

Monitor EGT to avoid a hot start. If uneven or intermittent acceleration is accompanied by a rapid rise in EGT, shut down engine and immediately investigate. During starting or acceleration, the MAXIMUM allowable EGT is 760°C. If this limit is exceeded, perform a hot end inspection. If during the start operation of T53-L-5, T53-L-9 or T53-L-9A engines, EGT exceeds 620°C for more than five seconds, record a hot start on DA Form 2408-13, and three such hot starts shall require a hot end inspection. If during the start operation of the T53-L-11 or T53-L-13 engines, EGT exceeds 650°C for more than five seconds, perform a hot end inspection.

e. Release Starter Switch at 40% nI speed. B 13 42%.

f. Slowly advance the throttle over the ENGINE IDLE stop.

g. INVERTER—Spare ON.

h. APU — 0FF, Battery — ON.

i. ENGINE and TRANSMISSION OIL PRESSURES—CHECK.

Caution

If no oil pressure is evident at this time, shut down engine immediately and investigate the cause.

j. START FUEL switch—ON (if installed).

k. Radios and Headsets—ON.

3-21. Engine Run-Up. Retard the throttle to the ENGINE IDLE stop and check the following:

a. GAS PRODUCER RPM:

(1) A and B 5 58% to 62%.

(2) B 9 9 A 11 56% to 58%.

(3) B 13 70% to 72%.

b. ENGINE and TRANSmission OIL PRESSure—in the green.

c. FUEL PRESSURE—in the green.

d. CAUTION panel and MASTER CAUTION —all lights OFF.

e. LOW RPM switch—AUDIO then OFF.

f. Copilot's attitude indicator—CAGE.

g. FUEL (QUANTITY) GAGE TEST switch —TEST.

h. Pilot's Attitude Indicator — SET.

i. B Fuel Pump Check — Left fuel boost circuit breaker OUT, check pressure gage for indication, then pull right fuel boost circuit breaker OUT; leave both circuit breakers out for at least 10 seconds, checking for a fuel pressure indication of zero and continued normal engine operation; left fuel boost circuit breaker IN. Check for pressure indication. Place right fuel boost circuit breaker IN.

j. PITOT HEATER — ON — note LOAD meter increase then OFF.

k. AC power voltmeter—CHECK all Phases for 115 (plus or minus three) volts (on SPARE INVerter).

l. INVerter—MAIN ON.

m. AC power voltmeter—CHECK all phases for 115 (plus or minus three) volts.

n. VM selector—CHECK all positions and leave in NON-ESSential BUS position.

o. STARTER—GENerator-STand BY GENerator.

p. MAIN GENerator—OFF note that MAIN GENerator LOADmeter zeros and STand BY GENerator LOAD meter registers.

q. VM selector—CHECK voltage zero (with NON-ESSential BUS power OFF).

r. NON-ESSential BUS-NORMAL ON.

s. VM selector—MAIN GENerator.

t. MAIN GENerator—ON—note that MAIN GENerator LOAD meter registers and STand BY GENerator LOADmeter zeros.

u. STand BY GENerator—AS necessary.

v. Deleted.

w. Increase throttle slowly to FULL OPEN noting that the engine rpm stabilizes at 6000 plus or minus 50 rpm. Then accomplish the following:

x. All engine and transmission instruments normal or in the green.

y. DE-ICE switch—ON. Note EGT rise.

z. DE-ICE switch—OFF. Note EGT decrease.

aa. Deleted.

ab. LOW RPM switch—AUDIO.

ac. GOVernor RPM INCRease — DECRease switch. Actuate through full range:

A 5800 to 6700 rpm plus or minus 50 rpm set at 6400 rpm.

B 6000 to 6700 rpm plus or minus 50 rpm set at 6600 rpm.

Note

Check that audio LOW RPM warning ceases and visual LOW RPM warning light goes off.

ad. FORCE TRIM — OFF — Check control freedom.

ae. HYDRaulic CONTROL — OFF — CAREFULLY check for control freedom then—ON.

540 **Note**

Freedom of controls check not required unless rotor head, swashplate, boost cylinders, or stabilizer bar have been replaced, or control rigging changes made other than adjustment of main rotor or tail rotor pitch link since last flight.

540 Check System number 1 and system number 2 then BOTH.

af. FORCE TRIM — ON.

ag. 540 Collective accumulator switch — ON.

ah. Communication and Navigation Radios—Perform complete operational check of all radios and posiiton to ON, as desired; set course selectors and indicators as desired.

ai. ANTI-COLLision light—ON.

Note

Use of the anti-collision light on the ground shall be kept to an absolute minimum because excessive heat created in the unit, while on the ground, is detrimental to bulb life, thus increasing maintenance problems. In addition, operating the anti-collision light could confuse rescue operations, since emergency ground vehicles use a similar light.

540 **3-21A. Hydraulic Power System with Collective Accumulator.** (Serial No. 66-491 and subsequent.) a. A daily check of the collective accumulator gas precharge shall be made. Proper precharge is indicated when the accumulator gage needle is in the green zone of the dial. If precharge of accumulator is incorrect, deplete the accumulator of hydraulic oil by using the accumulator drain valve.

Note

Correct accumulator precharge is mandatory for proper operation of secondary collective power.

b. After the engine has been started, perform the following check:

(1) Place collective accumulator switch to OFF position.

(2) Turn hydraulic system No. 1 off. Caution panel indicator HYD PRESS NO. 1 should be illuminated. Check directional controls. Directional control system is not powered and will be evident by increased force to operate the controls.

(3) Turn hydraulic system No. 2 off. Caution panel indicator HYD PRESS NO. 2 should be illuminated and indicator HYD PRESS NO. 1 should be extinguished. Check directional controls. The directional control system is powered.

(4) Place hydraulic control switch to BOTH position. Indicator lights for both hydraulic systems should be extinguished.

(5) Place collective accumulator switch to ON position.

c. If the aircraft is inactive overnight or longer and the accumulator has not been depleted, the solenoid valve controlling the accumulator will be in the OPEN position regardless of the position of the hydraulic selector switch. In this case secondary collective power is on and the collective actuator for hydraulic system No. 1 is pressurized. Servo valve internal leakage has depleted the accumulator. This is normal.

3-22. Before Take-Off. Just prior to take-off check:

Note

Taxiing as literally interpreted is not applicable for reason of the skid type landing gear.

a. Collective pitch control—Minimum pitch and friction adjusted as desired.

b. Cyclic control — Neutral or slightly into wind.

B Friction as desired.

c. Flight instruments—Check operation and settings.

d. Pitot heater switch—ON if required.

e. Cabin heater—As required (OFF for take-off and landing.)

f. Low RPM audio—Check—ON.

g. Dual tachometer—Check synchronization of needles.

h. Engine oil pressure, 60 to 80 psi.
B E 80 to 100 psi.

i. Engine oil temperature.

A 88°C (190°F) maximum.

B 93°C (200°F) maximum.

j. Transmission oil pressure.

A 40 to 60 psi.

B 45 to 55 psi.

k. Transmission oil temperature, 110°C (230°F) maximum.

l. Fuel pressure.

[A] 5 to 20 psi.

[B] [5] Approximately 12 psi.

[B] Approximately 13 to 15 psi.

Warning

Suspend operations immediately if engine or transmission oil pressure and temperature are not within operating limits.

m. Shoulder harness—LOCK.

3-23. Take-Off and Climb Procedures. Take-off and climb procedures are accomplished as follows:

Note

Pre-takeoff check will include determining if power is available for take-off by utilizing the GO-NO GO takeoff data placard (figure 2-5A) and clearing the area for other aircraft.

3-24. ***Normal Take-Off to Hover.*** The normal vertical take-off is the most common type of take-off, and should be used whenever possible. Normal vertical take-off can be accomplished at moderate altitude and with normal gross weights as shown in the Take-Off Distance Chart, Chapter 14. In this type take-off, the safety factor is high as the helicopter is lifted from ground vertically to a height of approximately three feet where the flight controls and engine may be checked for normal operation before continuing to climb. A normal vertical take-off is made in the following manner. Increase throttle to full open with the collective pitch full down. Select desired rpm with INCRease—DECRease switch. Place cyclic control in the neutral position. Increase collective pitch control slowly and smoothly until hovering altitude of approximately three feet is reached. Apply tail rotor pedal to maintain heading as collective is increased. As the helicopter breaks ground, make minor corrections with cyclic control to insure vertical ascent, and apply tail rotor pedals to maintain heading.

3-25. ***Normal Take-Off from Hover.*** Hover briefly to determine if engine and flight controls are operating properly. From a normal hover at approximately three feet altitude, apply forward cyclic pressure to accelerate smoothly into effective translational lift; maintain hovering altitude with collective pitch and maintain heading with tail rotor control pedals, until effective translational lift has been obtained and the ascent has begun. Then smoothly lower nose of helicopter to an attitude that will result in an increase of airspeed to climb speed. Adjust power as required to establish the desired rate of climb. Stabilize airspeed and torque pressure as soon as a smooth rate of acceleration will permit.

3-26. ***Maximum Power Take-Off.*** Place cyclic control in neutral position. With throttle full open, increase collective pitch smoothly. As the helicopter leaves the ground, continue increasing power to maximum available torque pressure (not to exceed red line) and assume at least a 40 knot airspeed attitude. As power is increased, maintain heading by smoothly coordinating tail rotor pedals. When sufficient altitude for obstacle clearance is obtained, smoothly increase airspeed and reduce power to establish a normal climb.

3-27. ***Crosswind Take-Off.*** In the event a crosswind take-off is required, normal take-off procedures are used. As the helicopter leaves the ground, there will be a definite tendency to drift downwind. This tendency can be corrected by holding the cyclic stick into the wind a sufficient amount to prevent downwind drift. When a crosswind take-off is accomplished, it is advisable to turn the helicopter into the wind for climb as soon as obstacles are cleared and terrain permits.

3-28. After Take-Off. As the helicopter accelerates from hovering flight to flight in any direction, it passes through a transitional period. If engine power, rpm, and collective pitch are held constant in calm air, a momentary settling will be noted when the cyclic control stick is moved forward to obtain forward speed. This momentary settling condition is a result of the helicopter moving from the ground cushion and the tilting of the tip-path plane of rotation of the main rotor blades to obtain forward airspeed. Wind velocity at the time of take-off will partially eliminate this settling due to the increased airflow over the main rotor blades. As wind velocity increases this settling will be less pronounced. After the helicopter accelerates forward to 10 to 15 knots airspeed, less power is required to sustain flight due to increase in aerodynamic efficiency as airspeed is increased to best climbing speed. Take-off power should be maintained until a safe autorotative airspeed is attained, then power may be adjusted to establish the desired rate of climb.

3-29. Climb. During climbs at low altitude a safe autorotative speed should be maintained so that in the event of engine failure, sufficient but not excessive speed is available to accomplish a safe autorotative landing. Airspeed to avoid at low altitudes are shown on figure 7-3. If necessary to clear ground obstructions after take-off, vertical climbs can be accomplished; however, operation within the shaded area on figure 7-3, should be held to a minimum. Accelerating the helicopter to the optimum climbing airspeed in a shallow climb eliminates critical settling and the possibility of the helicopter striking the ground on take-off.

3-30. Cruise Checks. These checks consist of constantly monitoring instruments, to be cognizant of any change in performance or condition.

3-31. Flight Characteristics. The helicopter is capable of delivering a maximum thrust commensurate with rotor-engine limitations and the density altitude in which it is operating. Maximum thrust can be utilized to obtain maximum airspeed, optimum rate of climb or, at some reduced airspeed, the maximum maneuver potentially. The capabilities of the helicopter may be employed within maximim limitations and in accordance with the environment under which operated. The capabilities of the helicopter in stabilized flight conditions are clearly and accurately defined in Chapter 7 and Chapter 14.

3-32. Before Landing Check. a. Crew—ALERTED.

b. Collective friction—ADJUST.

c. Governor—AUTO.

d. Engine.

A 6000 to 6400 rpm.

B 6400 to 6600 rpm.

e. Instruments—Check within operating limits.

f. Shoulder harness—LOCK.

3-33. Approach And Landing Procedures. Before approach and landing are accomplished, the pilot should evaluate the landing site for suitability of usable area by making a low speed pass into the wind over the intended landing site. Evaluate terrain, check wind direction, velocity and consistency. The gross weight of the helicopter must be considered; and the final step in evaluation of a landing, is the anticipated helicopter performance during landing and subsequent take-off.

3-34. Normal Approach. The objective of a normal approach and landing is to bring the helicopter to a hover over the spot of intended landing. The airspeed is decreased gradually and a constant approach angle of 8 to 10 degrees established at an engine speed of maximum rpm. In case of undershooting or overshooting, the approach angle is corrected by increasing or decreasing the power and the collective pitch level. As the landing spot is approached the airspeed and the rate of descent are decreased in order to attain a hovering attitude at approximately three feet.

3-35. Steep Approach. The steep approach procedure is a precision, power-controlled approach used to clear obstacle and to accomplish a landing in confined areas. The rate of descent in a steep approach should not exceed approximately 400 fpm with a constant approach angle of 12 to 15 degrees and some forward airspeed should be maintained at all times. Since a reasonable amount of power will be required to control the rate of descent (power required is governed by the gross weight and atmospheric conditions) a minimum amount of additional power will remain to accomplish a hover. The airspeed is decreased by holding the cyclic stick aft. The rate of descent is controlled by proper application of power and collective pitch lever. In the final stages of approach, the collective pitch lever is increased gradually and the cyclic stick is adjusted to maintain the originally established glide angle in a way which will reduce the rate of descent to zero the moment the hovering altitude is reached.

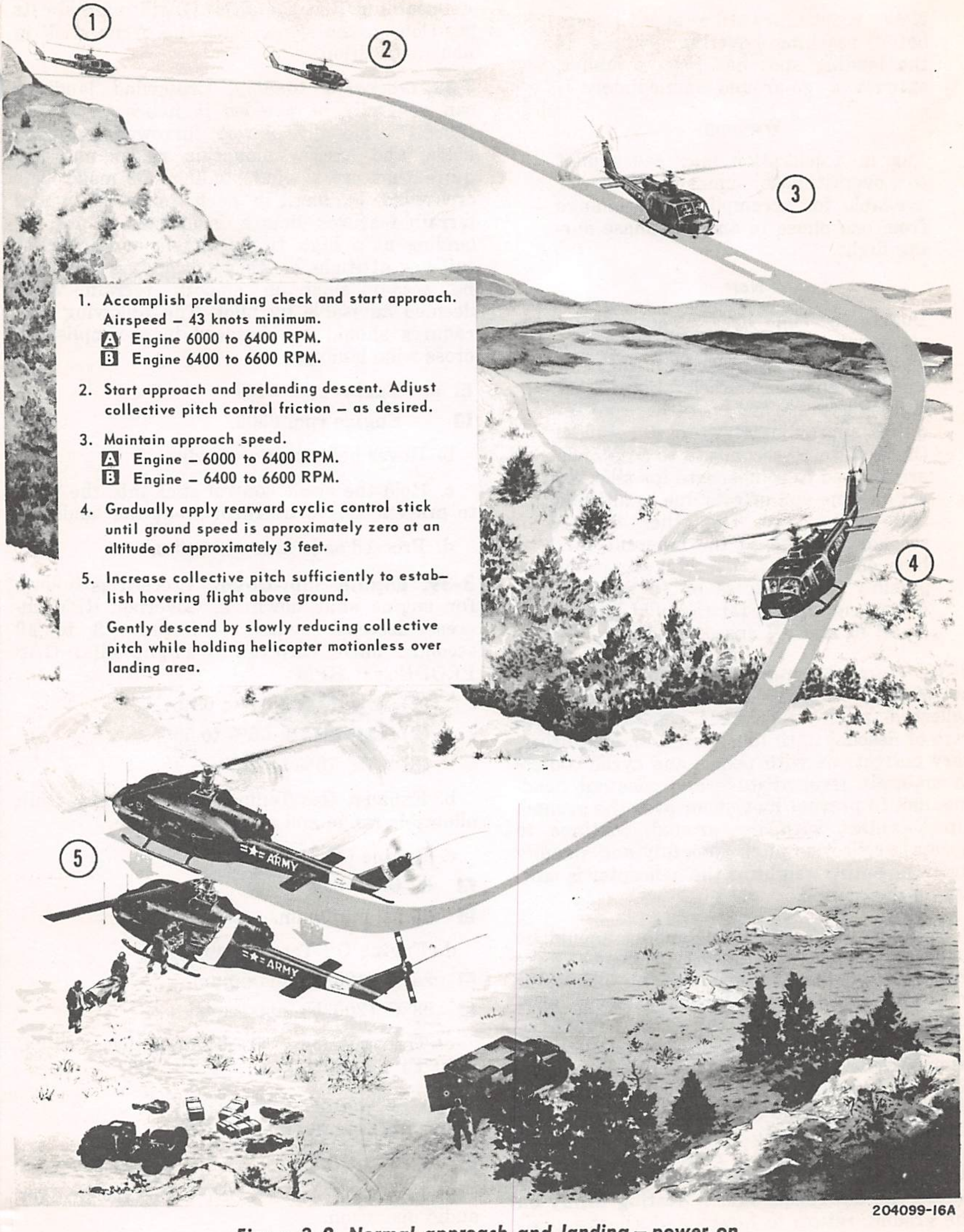

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Figure 3–2. Normal approach and landing – power on

Warning

Never reduce forward airspeed to zero before reaching hovering altitude. If the landing spot has been overshot, execute a go-around immediately.

Warning

Lag in acceleration may cause pilot to overestimate immediate power available for accomplishing a change from one phase to another phase during flight.

Note

Due to the time interval between instant when power is requested and when power is available (lag) in turbine engines, acceleration from flight idle to normal operating rpm requires approximately 8 to 10 seconds. Of the 8 to 10 seconds, 4 to 5 seconds are allowed to compensate for pilot reaction time and effects due to altitude and temperature. The other 4 to 5 seconds are due to the inherent turbine engine lag. The total lag could possibly be in excess of 10 seconds, depending on how far the pilot has allowed nI and nII speeds to drop.

3-36. Normal Landing. With an engine rpm at: 6000 to 6400 [A] 6400 to 6600 [B], decrease collective pitch to effect a constant, smooth rate of descent until touchdown, making necessary corrections with pedals and cyclic control to maintain level attitude and constant heading, and to prevent movement over the ground. Upon contact with the ground, continue to decrease collective pitch smoothly and steadily until the entire weight of the helicopter is resting on the ground.

3-37. Slope Landing. (Slope landing should be made cross-slope with skid type gear.) Make the slope landing by heading the helicopter generally cross-slope. Descend slowly, placing the upslope skid on the ground first. Coordinate reduction of collective pitch with lateral cyclic (into the slope) until the downslope skid touches the ground. Continue coordinating reductiton of collective pitch and application of cyclic into the slope until all the weight of the aircraft is resting firmly on the slope. If the cyclic control contacts the stop before the downslope skid is resting firmly on the ground, return to hover, and select a position where the degree of slope is not so great. After completion of a slope landing, and after determining that the aircraft will maintain its position on the slope, place the cyclic stick in neutral position.

3-38. Crosswind Landing. Crosswind landings can generally be avoided in helicopter operations. Occasionally, plowed, furrowed or eroded fields, and narrow mountain ridges may require that cross wind landings be made. The crosswind landing, in such instances where terrain features dictate, is utilized to prevent landing at a high tipping angle or dangerous tail low attitude. Cross wind landing may also be accomplished on smooth terrain when deemed advisable by pilot. The following procedures should be observed in accomplishing cross wind landing:

[A] a. Engine rpm 6400

[B] Engine rpm 6600.

b. Hover helicopter crosswind.

c. Hold the cyclic control stick into the wind to prevent side drift throughout the landing.

d. Proceed as in normal landing.

3-39. Engine Shut-Down. Proceed as follows for engine shut down: a. Governor RPM increase-decrease switch — decrease 8 to 10 seconds. Move throttle to Flight Idle: GAS PRODUCER RPM:

(1) [A] & [B] [-5] 58% to 62%.

(2) [B] [-9] [-9] [A] [-11] 56% to 58%.

(3) [B] [-13] 70% to 72%.

b. Exhaust Gas Temperature—Check within allowable range and allow to stabilize.

c. Engine Oil Pressure:

[A] 60 to 80 psi.

[B] 25 psi minimum.

d. Engine Oil Temperature:

[A] 88°C (190°F) maximum.

[B] 93°C (200°F) maximum.

e. Transmission Oil Temperature, 110°C (230°F) maximum.

f. Transmission Oil Pressure:

[A] & [B] [-5] 40 to 60 psi.

[B] 30 psi minimum.

*g. Low RPM Audio—OFF after checking for audio operation.

*h. FORCE TRIM—ON.

*i. Anticollision Light—OFF.

*j. Starter-Generator Switch—START.

*k. Radio and ICS Switches—OFF.

*l. Exhaust Gas Temeprature — Allow to stabilize (minimum one minute).

*m. Inverter Switch—OFF.

*n. Throttle—FULL OFF.

*o. **A** Fuel Boost Pump Switch—OFF.

p. **B** FUEL START Switch—OFF. (If installed.)

q. FUEL MAIN Switch—OFF.

A ***Note***

The main fuel valve must be closed as soon as the engine has been stopped, to insure that fuel does not drain from the engine fuel control and allow air to enter the fuel system. Fuel valve should remain in CLOSED position at all times when engine is not running, except when fuel boost pump is operating.

Note

After stopping the engine a fuel pressure indication in excess of 30 psi may be observed, due to the expansion of fuel trapped between the fuel control and fuel shut-off valve. This expansion is caused by heat radiation from the engine resulting in fuel pressure indication. Check valves located in the fuel system relieve pressure exceeding 40 to 45 psi and permit fuel to bleed into the fuel cells.

Caution

If a rapid rise in exhaust temperature is noted, with throttle closed and starter fuel off, motor the engine to allow temperature to stabilize within limits. Do not exceed 40 seconds continuous starter application.

3-41. Before Leaving The Helicopter: Check the following:

a. All electrical switches — OFF.

b. Battery switch—OFF.

c. Collective pitch control — FULL DOWN and engage DOWN lock.

d. Cyclic Friction—ON.

e. Rotor Blades—Tie down.

f. Install covers as required.

Caution

In addition to the established requirements for reporting any system defects, unusual and excessive operations, the pilot will also make entries in DA Form 2408-13 to indicate when any limits in the Flight Manual have been exceeded.

Figure 3-3. Deleted

CHAPTER 4
EMERGENCY PROCEDURES

Section I — Scope

4-1. Scope. This Chapter clearly and concisely describes the procedure to be followed in meeting any emergency except in connection with auxiliary equipment.

4-2. Scope of Emergency Procedures. Procedures in this Chapter describe action to be followed in emergencies, that can within reason be expected. In some cases emergency situations can be avoided by maintaining operation within the limitations described in Chapter 7.

Warning

Lag in acceleration may cause pilot to overestimate immediate power available for accomplishing a change from one phase to another phase during flight.

Note

Due to the time interval between instant when power is requested and when power is available (lag) in turbine engines, acceleration from flight idle to normal operating rpm requires approximately 8 to 10 seconds. Of the 8 to 10 seconds, 4 to 5 seconds are allowed to compensate for pilot reaction time and effects due to altitude and temperature. The other 4 to 5 seconds are due to the inherent turbine engine lag. The total lag could possibly be in excess of 10 seconds, depending on how far the pilot has allowed nI and nII speeds to drop.

4-3. Emergency operation of auxiliary equipment is contained in the Chapter insofar as its utility affects safety of flight. Detail descriptions of this equipment are given in Chapter 6.

4-4. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist Technical Manual TM55-1520-211-10CL.

Section II — Engine

4-5 through 4-8. *Deleted.*

4-9. Engine Failure During Take-Off/and While Hovering Below 10 Feet. The energy stored within the rotor system at normal operating rpm is sufficient to prevent a hard landing and can be utilized by use of the following procedure:

a. Instantly FREEZE collective pitch control lever and allow helicopter to settle.

Warning

Reduced engine noise levels in turbine powered aircraft delays detection of and corrective action for an engine failure. This results in rapid decay of rotor rpm. If during such failure the pilot fails to monitor engine instruments or fails to use low rpm warning devices, this condition is often further aggravated by an attempt to overcome altitude loss with increased collective pitch.

Warning

If collective pitch is increased prematurely when the engine fails, a loss in altitude will be delayed and result in insufficient rotor rpm and control. Without adequate rpm and control, it will be impossible to cushion the landing. Probable damage or injury will result.

b. Maintain heading with tail rotor pedals.

c. Just prior to ground contact INCREASE collective pitch to cushion landing.

d. A Fuel boost pump switch—OFF.

B Fuel main ON-OFF switch—OFF.

e. A Fuel valve switch—CLOSE.

f. Oil valve switch—CLOSE.

g. Battery switch—OFF.

Caution

Do not restart engine until cause of engine failure has been determined and corrected.

4-10. Engine Failure Within Shaded Area of HV Diagram. If engine failure occurs within the shaded area of the HV diagram (figure 7-3) accomplish the following procedure:

Caution

To reduce the possibility of a hard landing in the event of a power failure, vertical climb should only be used for obtaining obstacle clearance.

a. Reduce collective pitch sufficiently to maintain rpm which will provide energy to cushion the landing.

b. Maintain heading with tail rotor pedals.

c. Obtain forward speed, to reduce rate of descent if altitude permits.

d. Just prior to ground contact INCREASE collective pitch a sufficient amount to cushion the landing.

e. A Fuel boost pump switch — OFF.

B Fuel main ON-OFF switch — OFF.

f. A Fuel valve switch — CLOSE.

g. Oil valve switch — CLOSE.

h. Battery switch — OFF.

Caution

Do not restart engine until cause of failure has been determined and corrected.

4-11. Engine Failure During Flight. If engine failure occurs in flight proceed as follows:

Note

Rotor rpm will tend to overspeed in autorotation at high gross weights, high density altitude or when maneuvering. High rotor rpm may be kept within limits by judicial use of collective control.

a. Collective pitch — Adjust to maintain rotor rpm.

b. Reduce forward speed to desired autorotative airspeed for existing conditions, refer to Chapter 14.

c. If time permits accomplish the following:

(1) A Fuel boost pump switch — OFF.

(2) B Fuel main ON-OFF switch — OFF.

(3) A Fuel valve switch — CLOSE.

(4) Oil valve switch — CLOSE.

(5) Battery switch — OFF.

(6) Shoulder harness — LOCK.

(7) At low altitude, flare to lose excessive speed.

d. Execute an autorotative landing.

Warning

The aerodynamic cleanliness of the A and B helicopters leads to high rates of descent, especially following a change to a nose-low attitude.

Caution

After landing do not restart engine until cause of failure has been determined and corrected.

4-11A. Complete Engine Failure at Low Altitude — Low Airspeed.

a. Reduce collective pitch sufficiently to maintain rotor rpm, which will provide energy in the main rotor system to cushion the landing.

Note

If airspeed is 45 knots or below at time of engine failure, it will probably be best to maintain the pitch attitude present at the time of failure in order to execute timely deceleration prior to touchdown. If airspeed is above 45 knots, a slightly higher attitude may be used to facilitate deceleration and/or decrease glide distance; it will also assist in maintaining main rotor rpm. If altitude permits, the same procedures outlined in paragraph 4-11b. with regard to airspeed ranges and changes are applicable.

Warning

Do not attempt to lower the nose or gain airspeed for reduced rate of descent if failure occurs at low altitudes.

b. Maintain heading with tail rotor pedals.

c. Allow helicopter to settle to approximately 10 to 15 feet, then apply sufficient initial pitch to break the descent and further assist in decelerating forward speed.

d. Allow the helicopter to settle further to three to five feet above ground, then use remaining pitch to cushion touchdown in a level attitude.

4-12. Engine Restart During Flight. The condition which would warrant an attempt to restart the engine would probably be an engine flameout caused by a malfunction of the fuel control unit or failure of the boost pump(s). The decision to attempt an engine restart during flight is the pilot's responsibility and is dependent upon pilot's experience and the operating altitude. If an engine restart is to be attempted, proceed as follows:

Caution

When cause of engine failure is obviously mechanical DO NOT attempt an engine restart.

a. Establish autorotation.

b. Throttle — CLOSED.

c. Governor switch — EMERGENCY.

d. **A** Fuel boost pump switch — ON.

A Fuel valve switch — ON.

B Fuel START ON-OFF switch — ON (if installed).

B Fuel main ON-OFF switch — ON.

e. Battery switch — ON.

f. Starter-generator — START.

g. Starter-ignition switch — PULL and HOLD and simultaneously open throttle slowly to supply sufficient fuel for start.

Caution

Monitor EGT to avoid a hot start.

h. Gas producer tachometer — Observe for engine start indication.

i. **B** Fuel START ON-OFF switch — OFF at 400°C EGT (if installed).

j. Starter switch — RELEASE at 40 percent rpm nI speed. **B** **13** 42%.

k. Fuel pressure — CHECK within operating limits.

4-12A. Use of Governor (Emergency Position) During Starting. When mission dictates and starting the aircraft takes precedence, use of the emergency position of the governor can be used to prevent exceeding maximum allowable EGT. As it becomes apparent that EGT will exceed maximum allowable limit:

a. Freeze throttle.

b. Governor selector switch to emergency until EGT stabilizes in the green arc, then slowly advance throttle to increase nI RPM to 60% without exceeding maximum allowable EGT; do not "jockey" governor switch between AUTO and EMER positions. Retard throttle to the flight idle stop and simultaneously reposition governor switch to AUTO position.

4-13. Minimum Rate of Descent. The power-off minimum rate of descent is obtainable by maintaining a forward speed of approximately 55 to 60 knots, **5 4 0** 60 to 75 knots, depending on gross weight and altitude.

4-14. Maximum Glide. A forward glide speed of approximately 80 knots will result in obtaining maximum gliding distance.

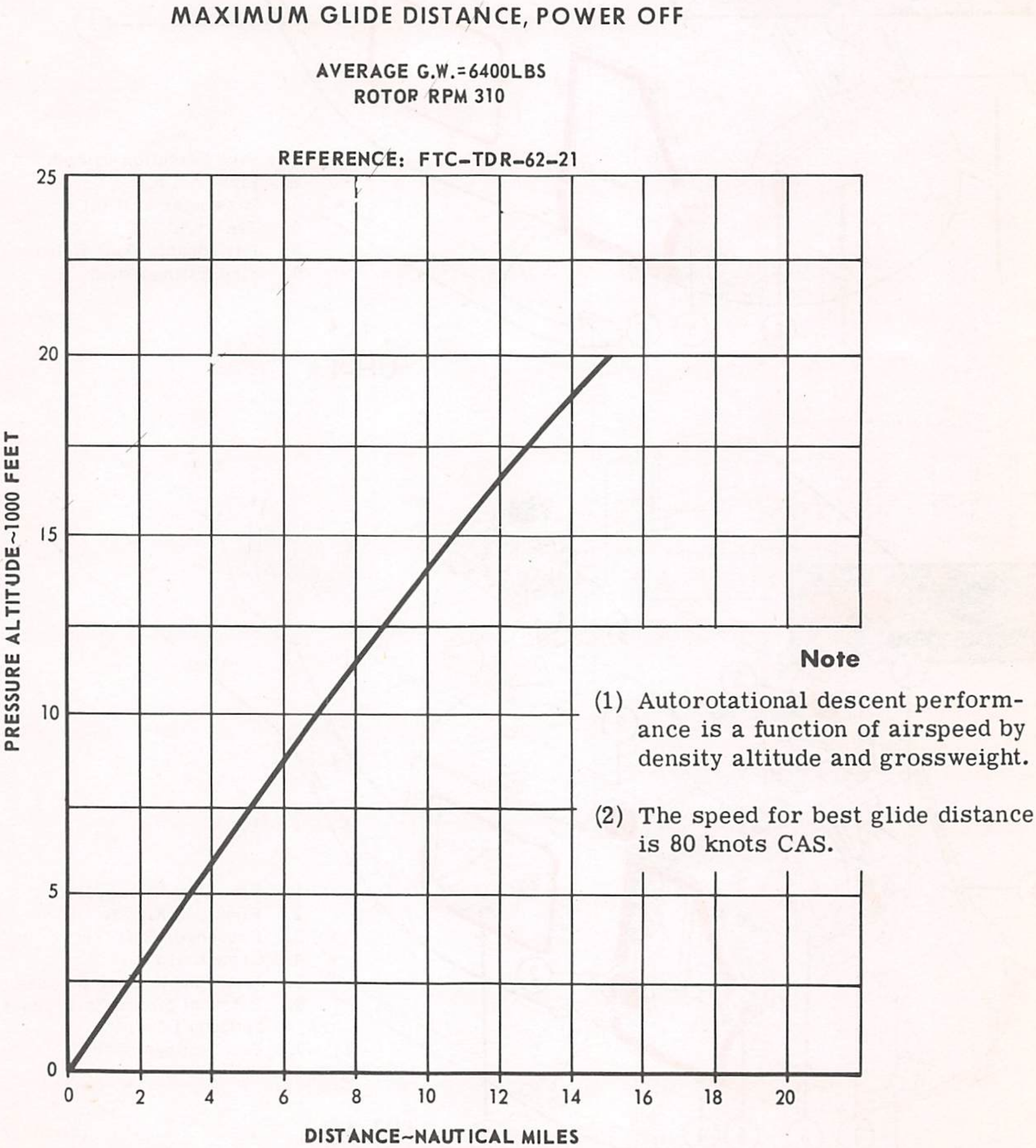

Figure 4-1. Maximum glide distance – power off

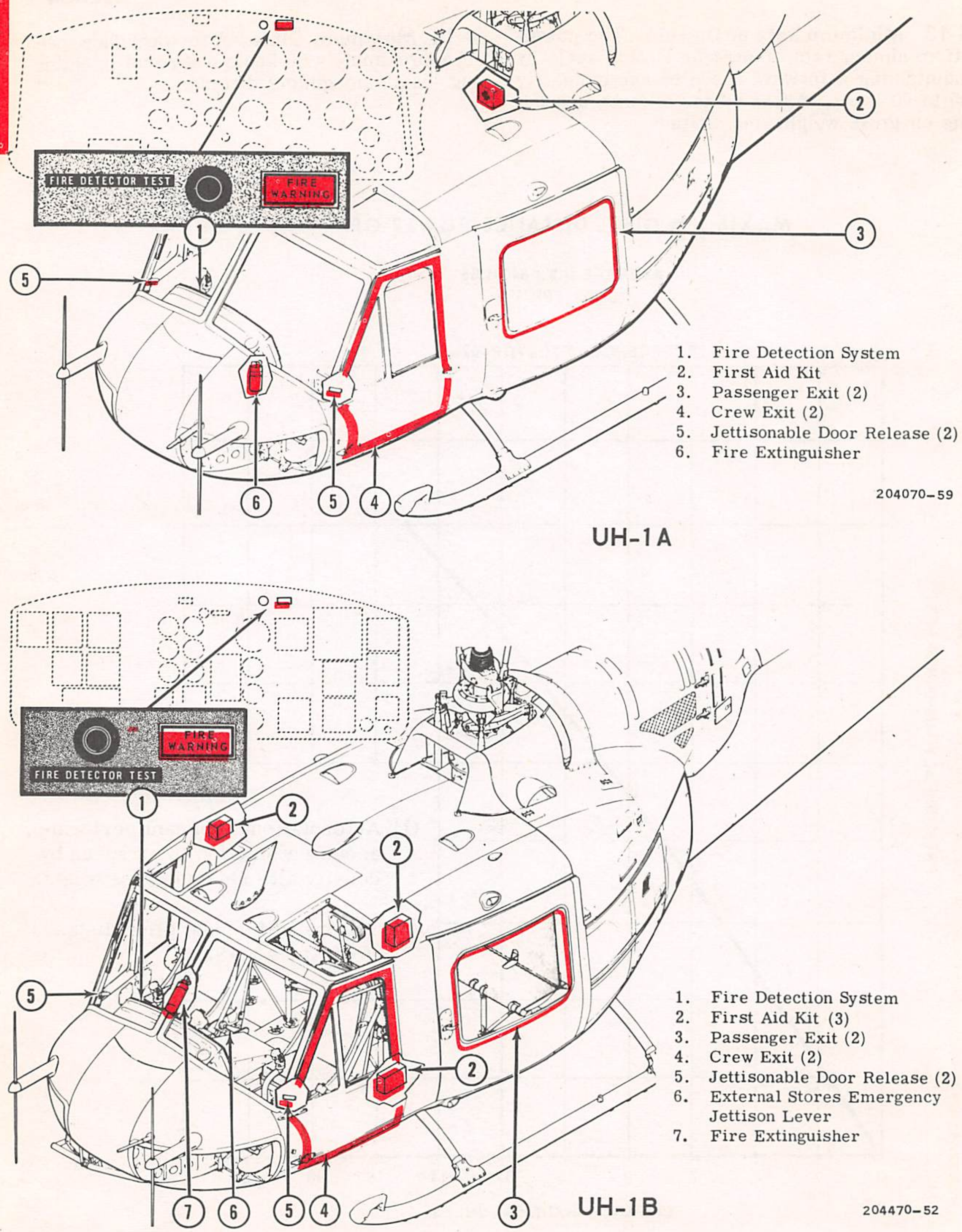

Figure 4-2. Emergency exits and equipment – typical

Section III — Rotors, Transmissions, And Drive Systems.

4-15. Tail Rotor Malfunction. a. General Discussion. A common tendency among helicopter pilots is to attempt to lump all types of tail rotor malfunction, and the corrective actions therefor, into a single category with a single solution. This is definitely not correct and any attempt to propose a single solution (emergency procedure) for all types of antitorque malfunction could prove disastrous.

Warning

The key to a pilot's successful handling of a tail rotor emergency lies in his ability to quickly analyze and determine the type malfunction that has occurred and to select the proper emergency procedure. Following is a discussion of some types of tail rotor malfunction and the probable effects therefrom.

(1) COMPLETE LOSS OF TAIL ROTOR THRUST. This is a situation involving a break in the drive system, such as a severed drive shaft, wherein the tail rotor stops turning and no thrust whatsoever is delivered by the tail rotor. A failure of this type will always result in the tailboom swinging to the left (left sideslip) and a left roll of the fuselage along the horizontal axis. It is likely that powered flight to a suitable area and execution of an autorotative approach is the proper emergency procedure.

(a) IN POWERED FLIGHT the degree of sideslip and the degree of roll may be varied by changing airspeeds and by varying power (throttle or pitch), but neither can be eliminated. Below an airspeed of approximately 30 to 40 knots, the sideslip angle becomes uncontrollable and the tail of the aircraft begins to revolve on its vertical axis.

(b) IN POWER-OFF FLIGHT (AUTOROTATION), the sideslip angle and the roll angle can be almost completely eliminated by maintaining an airspeed of 40 to 70 knots. When airspeed is decreased through approximately 20 to 30 knots, streamlining effect is lost and the sideslip angle becomes uncontrollable. Upon pitch application at touchdown, the fuselage will tend to turn in the same direction the main rotor is turning (tail pylon swings right, opposite torque effect) due to an increase of friction in the transmission system. When normal control manipulations are used, the deceleration and pitch application should not cause excessive changes in sideslip angle.

(2) FIXED PITCH SETTING. This is a malfunction involving a loss of control resulting in a fixed pitch setting, such as a severed control cable. Normally under these circumstances the directional pitch setting that is in the tail rotor at the time the cable is severed will, to some degree, remain in the tail rotor system. Whether the tail pylon hangs left or right is dependent upon the amount of pedal (which is related to power) applied at the time the cable is severed. Regardless of pedal setting at the time of malfunction, a varying amount of tail rotor thrust will be delivered at all times during flight.

(a) IF THE TAIL ROTOR PITCH BECOMES FIXED DURING AN APPROACH OR OTHER REDUCED POWER SITUATION (RIGHT PEDAL APPLIED), the tail pylon will swing left when power is applied, possibly to an even greater degree than would be experienced with complete loss of tail rotor thrust, and the overall situation may be even more hazardous. The best solution may be to autorotate immediately. Whether a successful autorotation could be accomplished is not certain, and is dependent upon the amount of pitch applied at the time of malfunction.

(b) IF THE TAIL ROTOR PITCH BECOMES FIXED DURING A TAKEOFF OR OTHER INCREASED POWER SITUATION (LEFT PEDAL APPLIED), the tail pylon will swing left when power is reduced (as in leveling off with cruise power). This swing to the right upon power reduction will probably be to a lesser degree than the left swing encountered in any previously mentioned situation. Under these circumstances, it appears that powered flight to an airfield and powered landing could be accomplished with little difficulty since the sideslip angle will probably be corrected when power is applied for touchdown. However, upon decreasing power to initiate the approach at destination, the sideslip angle will increase and remain so increased during the approach, but should be corrected when touchdown power is applied. Due to sideslip increase upon reduction of power to initiate the approach, a higher than normal approach speed may be beneficial. In this instance, powered landing may be the best solution; it is likely that autorotation could not be accomplished at all.

(c) IF THE TAIL ROTOR PITCH BECOMES FIXED DURING NORMAL CRUISE POWER SETTINGS, the helicopter reaction should not be so violent as in the previously described situations and, at speeds from 40 to 70 knots, the tail pylon should streamline with very little, if any, sideslip or roll angle. In this instance, autorotation may aggravate the situation because a reduction of power (torque) may then result in a right sideslip. It must be considered, however, that an increase in power at touchdown will result in a left sideslip if powered approach is used, although this sideslip should not be of a hazardous magnitude for touchdown.

(3) Loss of the tail boom or portion thereof. The gravity of this situation is dependent upon the amount of weight lost. If the loss is small, such as "aft of the 90° gear-box," the situation would be quite similar to "complete loss of tail rotor thrust." If more than that is lost, immediate autorotation may be the only (if any) solution of possible value.

b. Emergency Procedure For In-Flight Antitorque Malfunction.

(1) If the situation (altitude) permits, immediately reduce collective pitch (power) as an aid in gaining maximum possible control (trim) of the helicopter under the existing circumstances. Rolling off power (throttle) is not considered necessary at this time.

(2) The pilot should immediately analyze the existing emergency to the best of his ability before taking further action. The courses of action available will normally be —

(a) Autorotate immediately to a secure and improved landing area, if such area is available. This should be accomplished where possible under all circumstances, except as described in paragraph b(2)(c) below. The autorotative technique to be used is described in paragraph b(2)(b) below.

(b) If a safe landing area is not immediately available, continue powered flight to a suitable landing area by gradually applying power to assume a level powered flight circumstance, with an airspeed dictated by the limitations of the emergency condition. This airspeed should be that which is most comfortable to the pilot between 40 and 70 knots, indicated. When the landing area is reached, make a full autorotative landing, securing the engine (SWITCHES OFF) when the landing area is assured. During the descent, an indicated 60 knots airspeed should be maintained and turns kept to an absolute minimum. If the landing area is a level, paved surface, a run-on landing with a touchdown airspeed between 15 and 25 knots should be accomplished. If the field is unprepared, start to flare from about 75 feet altitude, holding so that forward groundspeed is at a minimum when the helicopter reaches 10 to 20 feet; execute the touchdown with a rapid collective pitch pull just prior to touchdown in a level attitude with minimum ground roll (zero, if possible).

(c) If the pilot has determined that the tail rotor pitch is fixed in a "left pedal applied" position (tail rotor delivering thrust to the left), autorotative landing should not be attempted. The pilot should return to powered level flight at a comfortable airspeed, which will be dictated by the degree of sideslip and roll; continue powered flight to the nearest improved landing area; and execute a running landing with power and a touchdown speed between 20 and 30 knots. In this approach, the sideslip angle will be corrected, to some degree, when power is applied to cushion the touchdown. However, upon decreasing power to initiate the approach to the landing area, the sideslip angle will increase for the duration of the approach, but should be corrected when touchdown power is applied.

c. Emergency Procedure for Antitorque Malfunction While at a Hover. The best solution for antitorque failure while at a hover is normally to autorotate immediately. However, the exception described in paragraph (2)(c) above still applies. In this instance, gradually reduce pitch to accomplish a powered touchdown.

4-16. Deleted.

4-17. Deleted.

4-18. Deleted.

Section IV — Fire

4-19. Engine Fire During Starting. An engine fire during starting will be caused by an overloading of fuel in the combustion chamber and a delayed ignition of the fuel resulting in flame emitting from the tailpipe. To extinguish fire proceed as follows:

a. Throttle—CLOSE and continue to crank engine.

b. **A** Fuel boost pump switch—OFF.
A Fuel valve switch—CLOSE.
B Fuel main ON-OFF switch—OFF.

c. Battery switch — OFF after fire extinguished.

4-20. Engine Fire During Flight. Immediately enter autorotation and prepare for power-off landing and accomplish the following.

a. Throttle—CLOSE.

b. **A** Fuel valve switch—CLOSE.
A Fuel boost pump switch—OFF.
B Fuel main ON-OFF switch—OFF.

c. Battery switch—OFF.

d. Generator switch — OFF, except when power is required to operate lights or avionic equipment.

e. Shoulder harness—LOCK.

f. Execute an autorotative descent and landing.

Caution

After landing do not attempt to restart engine until cause of fire has been determined and corrected.

4-21. Fuselage Fire. In the event of a fuselage fire, proceed as follows:

a. Airspeed — REDUCE TO MINIMUM to lessen possibility of spreading fire.

b. If smoke enters cabin, open pilot's sliding windows, cabin ventilators and cargo doors.

c. Battery switch—OFF.

d. Generator switch—OFF (ON if lighting or avionic equipment are to be used).

e. Accomplish landing and use fire extinguisher if fire is not severe.

Warning

Fire extinguisher fluid vapors are toxic and use should be limited to well ventilated areas.

4-22. Electrical Fire. The electrical circuits are individually protected by circuit breakers that automatically interrupt power to aid in the prevention of fire when a short circuit or malfunction occurs. To further identify and isolate the defective system, if necessary, proceed as follows:

Caution

In the event of any electrical fire or of smoke in the cockpit that cannot be quickly and positively ascertained and eliminated, the pilot should land as soon as possible.

a. Instrument—CHECK for correct reading.

b. Battery and generator switches—OFF.

c. Circuit breakers—OUT.

d. Generator switch—ON, if generator circuit is shorted, return generator switch to OFF, and turn battery switch ON.

e. Circuit breakers — IN one at a time, and allow a short period of time to identify defective circuit.

Note

Flight operation can be maintained without battery and generators; however, most instruments will not function, as they are electrically powered.

4-23. Smoke and Fume Elimination. Smoke or toxic fumes entering the cabin can be exhausted by the following procedure:

a. Pilot's and copilot's windows — Slide OPEN.

b. Cabin ventilators — OPEN.

c. Cargo doors — OPEN.

Note

If smoke or fumes are caused by an electrical fire, isolate the defective circuit as outlined under ELECTRICAL FIRE.

Section V — Fuel System

4-24. A Helicopter Fuel Boost Pump Failure. Malfunction of the fuel boost pump will be evident by the illumination of the master caution light and the FUEL PRESSure light located on the CAUTION panel and the procedure is as follows:

Note

Fuel pressure drop — Engine operating normally. Continue flight to the nearest available area and land immediately to determine cause of indication and/or malfunction.

a. If altitude permits, descend to pressure altitude of 4600 feet or less.

b. Fuel boost pump switch — ON.

c. Fuel valve switch — OPEN.

d. Fuel, oil valve, and fuel pump circuit breakers IN.

e. Deleted.

f. Deleted.

B Note

UH-1B helicopters are equipped with two separate fuel boost pumps. Either one is capable of sustaining normal flight. Upon landing, however, both pumps should be put in working condition before new flight.

B Warning

The 20 MINUTE FUEL caution light is not valid if either boost pump is inoperative. The reason being that the left fuel cell is mounted lower in the airframe than the right. If the left-hand pump fails, there will be approximately 55 pounds of unusable fuel remaining. If the right-hand pump fails, there will be approximately 35 pounds of unusable fuel. For purposes of standarization: If a boost pump caution light is on and the 20 MINUTE FUEL caution light illuminates, there will be enough fuel for approximately 5 minutes of flight at cruise power. This does not apply to 5 4 0 helicopters.

4-25. Engine Fuel Control Malfunction. Malfunction or failure of the engine fuel control unit will be evident by a loss of power due to lack of fuel or feeding too much fuel into the engine, which will cause a repeated number of loud noises to emit from the tailpipe and will sound like backfiring. This is called compressor stall. In the event of a control unit malfunction or failure, proceed as follows:

a. Collective pitch control lever — Down to maintain rotor rpm.

b. Throttle — RETARD TO FLIGHT IDLE.

c. Governor switch — EMERGENCY position.

d. Throttle — ADVANCE slowly and firmly to obtain engine operating rpm.

Warning

When operating on the emergency fuel system, the throttle must be manually adjusted to maintain engine rpm. Throttle movement shall be performed at a slower rate to minimize the possibility of flameout or compressor stall.

4-26. The engine fuel system is as near fail-safe as possible, because the fuel pump is a dual element unit, either element is capable of supplying engine fuel requirements. Failure of one pump element will illuminate the master caution light and the caution panel. A FUEL PRESS B ENGINE FUEL PUMP warning light. Then extinguish the master caution light, move the caution panel switch to RESET: however, the warning light will remain illuminated.

Section VI — Electrical System

4-27. Electrical Power System Failure. Complete failure of the electrical system is improbable because the primary dc power normally supplied by the main generator will be furnished by the standby generator and battery in the event of a main generator failure. Evidence of generator failure will be provided by illumination of the DC GENerator fault light and the MASTER CAUTION light. If the generators have not failed and the circuit has opened, reset as follows: MAIN GENerator and STBY GEN FIELD circuit breakers on dc circuit breaker panel, push to check, move main panel switch to extinguish caution panel light.

Note

The battery switch should be placed in the OFF position in the event the main generator has failed and standby generator is supplying power to the essential bus. This will conserve battery power for use as a secondary emergency power source.

Note

Turn off all non-essential electrical equipment to prevent overload of the standby generator.

4-28. AC Inverter Failure. Failure of the main inverter will be evident by illumination of the master caution light and the INST INVTR fault light on the caution panel. In the event of a main inverter failure, check the MAIN INVerter POWER and INVerter CONTrol circuit breakers by pushing IN. If main inverter power is not restored, position INVTR switch to SPARE ON.

Note

The main and spare inverters afford the same power output.

Section VII — Hydraulic System

4-29. Hydraulic Power System Failure. Hydraulic power failure will hardly be detected in the control system until control movements are executed. When the controls are moved it will be evident that the source required for control movement is increased and moderate feedback forces will be felt. Control motions will result in normal flight reactions in all respects except for the increased force required for control movement. In the event of a hydraulic power failure, proceed as follows:

a. HYDraulic CONtrol circuit breaker — Check IN.

b. HYDraulic CONTROL switch — ON, OFF if power is not restored.

c. Airspeed — Adjust as desired to obtain most comfortable control movement level.

d. Landing — Accomplish as soon as practical. Use technique described in Chapter 3, paragraph 3-67.

5 4 D 4-30. Emergency Operation — Dual Hydraulics. With either system OFF, the helicopter is controllable at speeds from zero to maximum operating speed. However, cyclic and pitch control movement becomes extremely difficult at speeds below that necessary for effective translational lift.

5 4 D 4-30A. Hydraulic Power System (With Accumulator) Failure. (Serial No. 66-491 and Subsequent.)

a. System No. 1 failure (evident by HYD PRESS NO. 1 caution panel light). Hydraulic accessories such as armament will be inoperative. Cyclic, collective, and directional control will be normal except as noted.

b. System No. 2 failure (evident by HYD PRESS NO. 2 caution panel light). Directional control will be inoperative. Cyclic and collective control will be normal except as noted.

Note

During operation on one system, cyclic and collective feedback will be evident during maneuvers at high gross weights.

c. Failure of Both Systems.

(1) Airspeeds—as desired to obtain most comfortable control movement level. Establish trim attitude.

(2) Check collective accumulator switch OFF (to retain stored energy).

(3) The selection of a landing site should depend on the following:

(a) The ability to make a rather flat approach.

(b) Surface suitable for a touchdown of 10 to 15 knots.

(c) The rate of deterioration of lock and load control system if any. The aircraft may be flown for extended periods of time with both systems failed. The degree of lock and load deterioration and pilot fatigue are the limiting factors.

(d) Amount of support equipment and personnel at the landing site.

(4) Prior to starting approach—collective accumulator switch ON. Avoid excessive collective control correction.

Note

During boost-off flight with the collective accumulator switch in the ON position, stored energy will be depleted during any collective motion, or lost overboard, should there be damage to the lines between the accumulator and the hydraulic cylinder. Normal operation of the collective accumulator will provide six full strokes of collective motion (three full up and down cycles).

540 **4-30B. *Depletion of Collective Accumulator Pressure.*** Collective accumulator depletion will be evident by the force required for collective movement. As collective stored energy is depleted, the force required to move collective control to the high or low position will increase and will be more evident at low airspeeds. A touchdown airspeed of 20 to 30 knots is recommended if terrain permits.

Section VIII — Landing and Ditching

4-31. Emergency Descent. The power off minimum rate of descent is obtained by maintaining a forward speed glide of approximately 55 to 60 knots, 540 60 to 75 knots, dependent on gross weight and altitude.

4-32. Emergency Landing. Emergency landings can be accomplished without undue difficulty. They are executed in near the same manner as a power-on landing. The portion of the procedure which is different, is the final touchdown which will be easier to perform with a slight forward speed at time of contact. It should be remembered that landing distance (ground roll) is limited by the skid type landing gear and ground surface condition. Refer to ENGINE FAILURE DURING FLIGHT procedure contained in this Chapter.

Note

When anticipating a crash landing or ditching — and time permitting — locking of the shoulder harness provides an added safety precaution over that of the automatic lock. However, depending on pilot's seat adjustment and cockpit configuration, certain controls and switches may become impossible with the harness locked. Each pilot should determine for himself to what extent, in each type aircraft he flies, a locked shoulder harness would interfere with aircraft and systems control.

4-33. Landing In Trees. A power-off landing into heavily wooded area can be accomplished by executing a normal autorotative approach

Section X — Bail Out

4-39. Bail Out. Helicopter design, flight characteristics and autorotation qualities virtually eliminate the necessity for bail out. however, if a decision is made to bail out, accomplish as follows:

a. Warn passengers of intent and radio position.

b. Reduce airspeed to approximately 20 knots, if doors are to be jettisoned.

c. Release jettisonable doors and slide cargo doors open as required.

d. Set controls to establish CRUISE forward speed, nose slightly down flight attitude.

e. Bail out when ready through nearest exit.

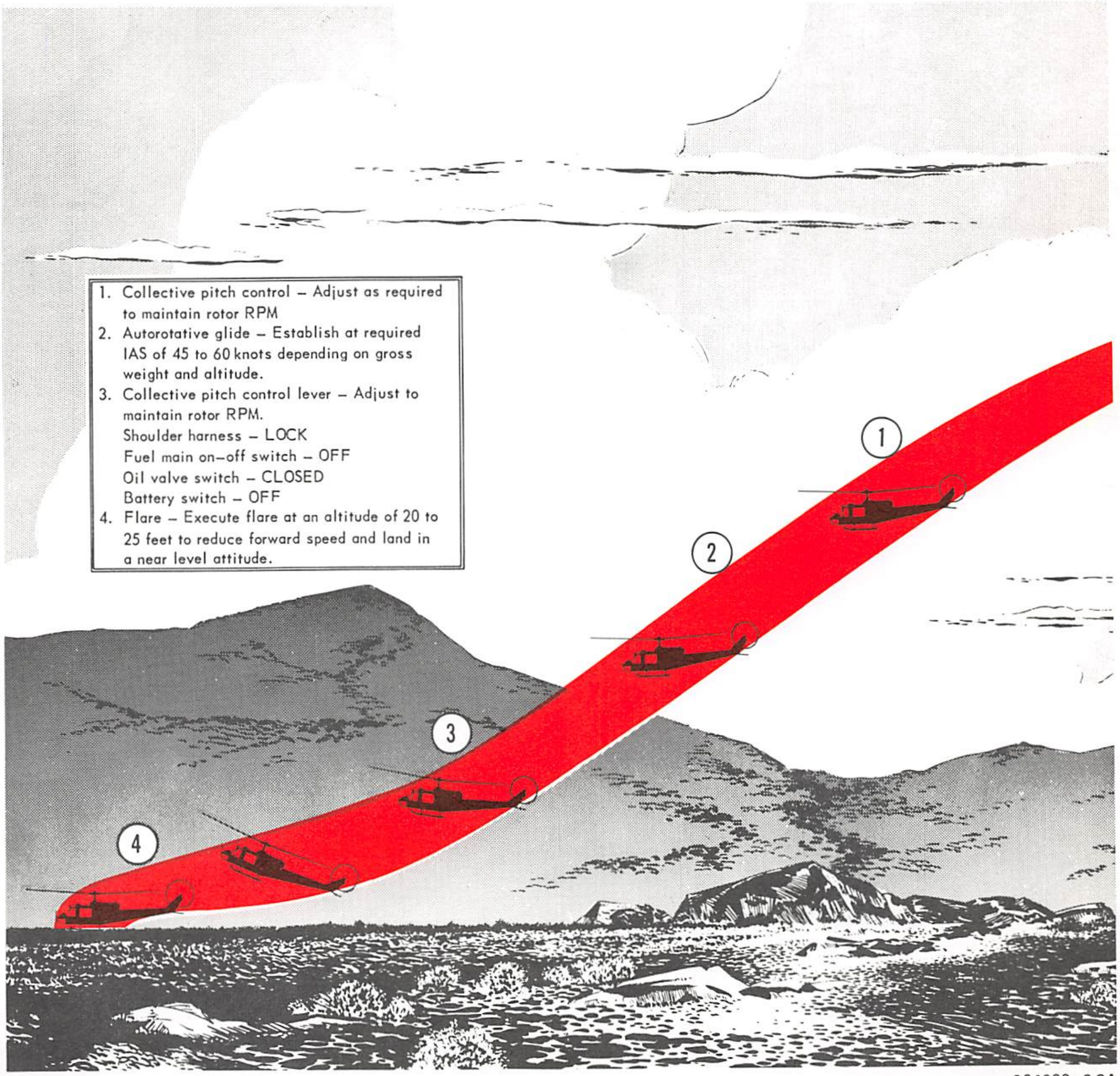

Figure 4–3. Approach and landing – power off