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CUT ON LINE TO FIT TM 1500-1 INSERT

STANDARDIZATION OF HELICOPTER MANEUVERS

OH-13 E, G & H

JANUARY 1970

DEPARTMENT OF ROTARY WING TRAINING

UNITED STATES ARMY AVIATION SCHOOL

FORT RUCKER, ALABAMA

This document supersedes all previous editions.

NOTES

1. Engine rpm for all "power-on" maneuvers will be 3100.

2. For a detailed discussion of the maneuvers and the aerodynamic terms used, consult TM 1-260, with current changes.

3. Consult the appropriate syllabus of instruction to determine in which stage each maneuver will be taught.

STANDARDIZATION
OF
HELICOPTER MANEUVERS
OH-13 E, G, AND H

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PART I. MANEUVERS

1. TAKEOFF TO HOVER

a. Required.

(1) Pretakeoff check completed prior to beginning maneuver.

(2) Vertical ascent.

(3) Constant heading.

(4) Stabilize at a 3-foot hover.

b. Analysis of maneuver. Increase throttle to operating rpm with collective pitch FULL DOWN. Place cyclic in the NEUTRAL position. Increase collective pitch with a smooth, constant, positive pressure until hovering altitude of 3 feet is reached. Apply antitorque pedal to maintain heading as collective pitch is increased. As the helicopter leaves the ground, make minor corrections with cyclic to insure a vertical ascent and apply antitorque pedals to maintain directional control. During the ascent, maintain operating rpm.

2. HOVERING TURNS

a. Required.

(1) Altitude at constant 3-foot hover.

(2) Remain over pivot point.

(3) Constant rate of turn. (Maximum rate of turn of 360° in 15 seconds is recommended for training.)

b. Analysis of maneuver. Apply pressure on desired pedal to initiate turn, using pressure and counterpressure on pedals to maintain constant rate of turn. Coordinate cyclic to maintain position over pivot point. Maintain altitude and rpm with collective pitch and throttle. Avoid abrupt anti-torque pedal movements.

3. SIDEWARD FLIGHT

a. Required.

(1) Altitude at constant 3-foot hover.

(2) 90° clearing turn in direction of sideward flight.

(3) Constant rate of movement (not to exceed 5 knots).

(4) Flightpath perpendicular to heading.

b. Analysis of maneuver. Maintain direction of flight with cyclic. Keep heading perpendicular to the ground track with pedals. Maintain altitude and rpm with collective pitch and throttle.

4. REARWARD FLIGHT

a. Required.

(1) Altitude at constant 3-foot hover.

(2) 90° clearing turn.

(3) Constant rate of movement (not to exceed 5 knots).

(4) Flightpath 180° to heading.

b. Analysis of maneuver. Maintain direction of flight with cyclic. Keep heading parallel to the ground track with pedals. Maintain altitude and rpm with collective pitch and throttle.

5. LANDING FROM A HOVER

a. Required.

(1) Constant heading.

(2) Vertical descent.

b. Analysis of maneuver. Decrease collective pitch to effect a constant, smooth rate of descent until touchdown, making necessary correction with pedals to maintain constant heading and with cyclic to maintain hovering attitude and to prevent movement (drift) 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. Coordinate throttle with collective pitch to maintain rpm. Apply cyclic as necessary to level the rotor system.

6. TAXIING ON THE GROUND

a. Required.

(1) Skids parallel to the direction of movement.

(2) Slow movement over the ground.

b. Analysis of maneuver. Adjust engine rpm to 3100 with collective pitch in the FULL DOWN position. Place cyclic forward of neutral, but avoid hitting the forward limits. Utilize collective as required for starting, speed control, and stopping. Use antitorque pedals for directional control. When taxiing crosswind, adjust cyclic into the wind as required to maintain ground track and prevent lateral drift. AVOID FAST TAXIING. If helicopter starts to tip or enter translational lift, reduce collective pitch immediately.

7. <u>STRAIGHT-AND-LEVEL FLIGHT</u>

a. Required.

(1) Maintain constant altitude.

(2) Constant airspeed of 55 knots (normal cruise) or 40 knots (slow cruise).

(3) Constant ground track.

b. Analysis of maneuver. In straight-and-level flight, control attitude and airspeed with cyclic. Maintain altitude with collective pitch. Coordinate antitorque pedals with power changes to maintain a constant heading. In crosswind conditions, maintain a straight ground track by <u>crabbing</u> the helicopter.

8. <u>LEVEL TURNS</u>

a. Required.

(1) Airspeed - as directed: 55 knots (normal cruise) or 40 knots (slow cruise).

(2) Constant altitude and degree (angle) of bank.

b. Analysis of maneuver.

(1) Govern the degree of bank by the rate of turn desired. Initiate the turn by applying lateral cyclic smoothly in the direction of turn. Once established, hold bank constant throughout the turn with cyclic.

(2) Apply slight fore or aft cyclic to maintain a constant airspeed.

(3) Make correction with collective pitch to maintain altitude. (Any change in power setting will require a pedal correction to maintain proper trim and rate of turn.)

(4) To return to straight-and-level flight on a desired heading, apply lateral cyclic to roll the helicopter smoothly from a bank to a level attitude. Make necessary corrections with cyclic and collective pitch to maintain altitude and airspeed. Plan the rollout so that all turning has stopped as the aircraft reaches a level attitude on the desired heading.

9. NORMAL CLIMB

a. Required.

(1) Constant ground track.

(2) Airspeed of 40 knots.

(3) 25 inches of manifold pressure.

b. Analysis of maneuver. Airspeed and attitude are controlled with the cyclic. Collective pitch is used to establish the desired rate of climb. Antitorque pedals are coordinated with power changes to maintain constant heading.

10. NORMAL DESCENT

a. Required.

(1) Constant ground track.

(2) Airspeed of 40 knots.

(3) 15 inches of manifold pressure.

b. Analysis of maneuver. Reduce collective pitch to attain 15 inches of manifold pressure. Coordinate throttle to maintain rpm and antitorque pedals to maintain a constant heading. Apply cyclic to establish an attitude that will smoothly attain or maintain required airspeed.

11. CLIMBING AND DESCENDING TURNS

a. Required.

(1) Constant rate of turn and degree of bank.

(2) 25 inches of manifold pressure for climb.

(3) 15 inches of manifold pressure for descent.

(4) Airspeed of 40 knots.

b. Analysis of maneuver.

(1) A climbing or descending turn is normally accomplished with a more shallow bank than a level turn at normal cruise speed, since the radius of turn is lessened by the slower airspeed.

(2) From a normal climb or normal descent, initiate the climbing or descending turn by applying lateral cyclic to roll the helicopter to the banked attitude that will result in the desired rate of turn. Once established, hold the bank constant throughout the turn.

(a) For a climbing turn, maintain rate of climb with collective pitch and proper trim with antitorque pedals. Maintain airspeed with cyclic. (If power setting remains constant, no pedal change should be required.)

(b) For a descending turn, maintain rate of descent with collective pitch and maintain proper trim with antitorque pedals. Maintain airspeed with cyclic. (If power setting remains constant, no pedal change should be required.)

(3) To return to a straight climb or descent from the turn, apply lateral cyclic. Maintain required manifold pressure setting and airspeed. To complete the turn on desired heading, plan the rollout as from a level turn.

(4) To establish a climbing or descending turn from straight-and-level flight, smooth coordination of collective pitch, cyclic, and antitorque pedal is required to establish a banked attitude.

(5) To establish straight-and-level flight from a climbing or descending turn, roll out of the turn as in (3) above, while simultaneously applying cyclic to obtain a 55-knot attitude. Apply sufficient power to accelerate to cruise airspeed while maintaining altitude. As cruise airspeed is obtained, reduce power to maintain desired altitude.

12. DECELERATIONS

a. Required.

(1) Entry airspeed - 55 knots.

(2) Minimum airspeed - 25 knots.

(3) Minimum altitude - 500 feet AGL.

b. Description of maneuver.

(1) This maneuver is primarily used to develop coordination of all controls but could be useful if a quick stop in flight is needed.

(2) Reduce collective pitch to descending power and simultaneously introduce a smooth, constant, aft pressure on the cyclic to slowly decelerate while maintaining altitude. Use antitorque pedals to maintain directional control.

(3) As airspeed is decreased, compensate for loss of lift by applying collective pitch to maintain altitude. Apply forward cyclic and introduce collective pitch as required to smoothly accelerate to entry speed. Maintain directional control with antitorque pedals.

13. TRAFFIC PATTERN

a. Required.

(1) Initial climb - 40 knots.

(2) Altitude - as directed.

(3) Airspeed - downwind 55 knots.

(4) Descent - deceleration to 40 knots.

b. Analysis of maneuver. After takeoff, climb straight ahead at required airspeed to required altitude, turn on the crosswind leg; continue to climb at required airspeed. The downwind turn may be made as the crosswind turn is completed, after reaching traffic pattern altitude, or initiated so that traffic altitude and airspeed are reached as the turn is completed. Maintain the required airspeed and altitude on the downwind leg. With due care for the helicopters being followed in the traffic pattern and for the spot of intended landing, start the descent and initiate a turn onto the base leg. Throughout the base leg, decrease the power to lose altitude; slowly decelerate the helicopter to an airspeed of 40 knots and when possible, achieve the base leg altitude and 40 knots airspeed simultaneously. Plan the turn from the base leg to the approach leg, aligning the helicopter with the selected lane at the assigned altitude and airspeed.

c. Wind drift correction.

(1) On takeoff leg below 50 feet, make wind drift correction by "slipping" the helicopter into the wind; above 50 feet, use the "crabbing" technique.

(2) On the crosswind, downwind, and base legs, make wind drift corrections by "crabbing" the helicopter into the wind.

(3) On the approach leg above 50 feet, make wind drift corrections by "crabbing" the helicopter into the wind; below 50 feet, make wind drift corrections by using the "slipping" technique.

14. NORMAL TAKEOFF

a. Required.

(1) Execute a 90° clearing turn.

(2) Pretakeoff check completed prior to beginning maneuver.

(3) Maintain constant heading.

(4) When climb is established:

(a) 40 knots airspeed.

(b) 25 inches of manifold pressure.

b. Analysis of maneuver.

(1) From a hover.

(a) From a stationary hover at a 3-foot altitude, apply forward cyclic to accelerate smoothly into effective translational lift. Maintain heading with antitorque pedals and hovering altitude with collective pitch until effective translational lift is obtained and the ascent has begun. Smoothly apply cyclic to attain an attitude that will result in acceleration to normal climb airspeed.

(b) Stabilize airspeed and manifold pressure as quickly as the smooth rate of acceleration will permit.

NOTE: If desired rate of climb cannot be obtained at 25 inches of manifold pressure, adjust power plus or minus 1 inch of manifold pressure to obtain desired rate.

(2) From the ground.

(a) Place cyclic slightly forward of neutral and smoothly increase collective pitch. As the aircraft leaves the ground, maintain heading with antitorque pedals, coordinate cyclic to accelerate the helicopter into effective translational lift as a 3-foot altitude is obtained. When the ascent has begun, coordinate cyclic to attain an attitude that will result in acceleration to normal climb airspeed.

(b) Stabilize airspeed and manifold pressure as quickly as a smooth rate of acceleration will permit.

15. NORMAL APPROACH

a. Required.

(1) Approach angle - 12°.

(2) Entry altitude - as directed.

(3) Entry airspeed - 40 knots (slow cruise).

b. Analysis of maneuver.

(1) To a hover. When the proper angle is intercepted, decrease collective pitch as required to establish and maintain the desired angle of descent. Maintain entry airspeed until such time as apparent groundspeed and rate of closure appear to be increasing. From this point, progressively decrease the rate of descent and forward speed to stop both descent and forward movement at a 3-foot hover over the intended landing spot. As forward speed is gradually reduced, apply additional collective pitch to compensate for the decrease in translational lift and to maintain the proper angle of descent.

(2) To the ground. Proceed as in "approach to a hover," except the approach is continued to the ground. Make the touchdown with zero groundspeed. Avoid either hard or excessively tail-low touchdown. Smoothly reduce collective pitch to FULL DOWN. Apply cyclic as necessary to level the rotor system.

16. HOVERING AUTOROTATION

a. Required.

(1) Altitude - not to exceed 3 feet.

(2) Vertical descent.

(3) Head helicopter into the wind.

b. Analysis of maneuver.

(1) Close throttle to the FULL OFF position. Simultaneously apply right pedal as required to maintain heading and apply cyclic as required to maintain position over spot. (While

closing the throttle, use caution not to raise or lower the collective pitch.)

(2) At approximately 1 foot above the ground, apply sufficient collective pitch to cushion the landing. After ground contact, with the helicopter resting firmly on the ground, smoothly lower collective pitch to FULL DOWN position. Apply sufficient cyclic to level the rotor system.

17. STANDARD AUTOROTATION

a. Required.

(1) Prelanding check - completed.

(2) Heading - into wind (or direction of traffic).

(3) Entry altitude - as directed.

(4) Entry airspeed - 55 knots.

(5) Rotor speed - 322 to 370 (370 maximum).

b. Analysis of maneuver.

(1) Entry.

(a) From an assigned altitude and point (at stagefields, this will be traffic pattern altitude, on final approach, and at the discretion of the IP) with airspeed of 55 knots, reduce collective pitch to full down, simultaneously correlating throttle to maintain 3100 engine rpm and then adjust throttle to establish 2300 engine rpm. (The initial point of entry may be varied on subsequent autorotations after estimating the angle of descent. Wind, load, and other influencing factors will be considered in determining the exact point to enter autorotation.) Maintain ground track by crabbing (above 50 feet) or slipping (below 50 feet) the helicopter.

(b) Adjust cyclic control as necessary to produce an attitude that will result in approximately 40 knots airspeed. During the initial descent, the airspeed may be varied to maintain a line of descent to the intended touchdown area.

(c) Check the rotor rpm in the green arc and the engine rpm 2300, and call out (for example), "Rotor in the midgreen; engine rpm 2300."

(d) Rotor rpm may be varied from the minimum area of the green arc upward so as not to exceed the redline.

NOTE: Within limits, minimum rpm will cause the glide to be extended. Maximum rpm will cause the glide to be shortened. Rpm and airspeeds required for maximum glide and minimum rate of descent operations vary. Refer to TM 55-1520-224-10 for rpm and airspeed figures. If the rotor rpm decays below the green arc, terminate the practice autorotation.

(e) Prior to passing through 100 feet AGL, the aircraft must be at APPROXIMATELY 40 KNOTS AIRSPEED, in a normal rate of descent and in position to terminate in the intended touchdown area.

(2) Final autorotative descent and termination.

(a) At approximately 100 feet AGL, apply aft cyclic control as necessary to initiate a smooth deceleration (as airspeed decreases, additional rearward cyclic pressure may be required to gain maximum deceleration effectiveness). Insure alignment of the aircraft with the runway by proper application of the antitorque pedals and cyclic control. Position collective as required to prevent rotor rpm from increasing above the green arc. Care must be exercised in attaining a decelerating attitude so that the cyclic control is not moved rearward so abruptly as to cause the helicopter to climb or excessive rpm to build. If conditions in paragraph 1(e) above are met, place throttle in override detent, and call out, "Rotor in the green, throttle in override."

(b) At approximately 5 to 10 feet (skid height), apply sufficient collective pitch to minimize the rate of descent and groundspeed. The amount of collective pitch applied and the rate at which it is applied will vary depending upon the wind, load, and other influencing factors. At an altitude of 1 to 3 feet (skid height) smoothly apply additional collective pitch as necessary to cushion the touchdown while using the cyclic to place the helicopter in a "skids level" attitude prior to touchdown.

(c) After ground contact is made, position cyclic as necessary and maintain direction and heading.

(d) Minimum ground slide is desired. However, the length of the ground slide will be effected by factors such as wind, landing area, density altitude, etc.

CAUTION

In an actual engine failure, the pilot will experience a loss of hydraulics due to the engine-driven hydraulic pump no longer receiving power. This condition may be simulated during practice autorotations by moving the hydraulic system's switch to the OFF position.

18. STANDARD AUTOROTATION (with turn)

a. Required.

(1) Prelanding check - completed.

(2) Entry altitude - as directed.

(3) Entry airspeed - 55 knots.

(4) Rotor speed - 322 to 370 (370 maximum).

(5) During descent - maneuvering turn (180° at stagefield).

b. Analysis of maneuver.

(1) Entry.

(a) From an assigned altitude and point (at stagefields, this will be at traffic pattern altitude, on downwind parallel with lane, and at the discretion of the IP) with airspeed of 55 knots, reduce collective pitch to full down, simultaneously correlating throttle to maintain 3100 engine rpm and then adjust throttle to establish 2300 engine rpm. (The initial point of entry may be varied on subsequent autorotations after estimating the angle of descent. Wind, load, and other influencing factors will be considered in determining the exact point to enter autorotation.)

(b) Adjust cyclic control as necessary to produce an attitude that will result in approximately 40 knots airspeed, and start a turn with coordination of cyclic control pedals. During the descent, the airspeed, degree of bank, and rate of turn may be adjusted as necessary to assist in reaching the intended touchdown area.

(c) Check the rotor rpm in the green arc and the engine rpm 2300, and call out (for example), "Rotor in the midgreen; engine rpm 2300."

(d) Rotor rpm may be varied from the minimum area of the green arc upward so as not to exceed the redline. Normal characteristics of the helicopter will require a small adjustment of the collective pitch prior to the turn in order for the rpm not to exceed the redline.

NOTE: Within limits, minimum rpm will cause the glide to be extended. Maximum rpm will cause the glide to be shortened. Rpm and airspeeds required for maximum glide and minimum rate of descent operations vary. Refer to TM 55-1520-224-10 for rpm and airspeed figures. If the rotor rpm decays below the green arc, terminate the practice autorotation.

(e) Prior to passing through 100 feet AGL, the aircraft must be at approximately 40 knots airspeed, in a normal rate of descent and in a position to terminate in the intended touchdown area.

(2) Final autorotative descent and termination is the same as paragraph 10b(2).

19. FORCED LANDING PROCEDURE

a. Practice forced landing. A practice forced landing is a simulated emergency situation designed to develop the student pilot's proficiency, reaction time, planning, judgment, and in the event of engine failure in flight, his capability to handle the emergency. It is intended to encourage the pilot to take full advantage of the many variables that are at his disposal to enable him to safely land the helicopter at a predetermined spot on the ground.

b. Analysis of maneuver.

(1) A practice forced landing will be initiated by the instructor pilot with a throttle reduction.

(2) The student will immediately lower the collective pitch to the FULL DOWN position while simultaneously applying RIGHT pedal, as required, to properly trim the helicopter.

(3) It is the responsibility of the instructor pilot to adjust and maintain engine rpm at 2300 to lessen the possibility of an actual engine failure.

(4) An autorotative turn will be made toward the intended landing area. The approach to the selected area must be planned and executed in such a manner as to cause the final approach to be generally into the wind.

(5) Except for the necessary maneuvering into position, accomplish the autorotative approach similar to the standard autorotation. Adjust the forward speed at the termination to permit a safe touchdown compatible with the terrain in the selected area.

(6) Check rotor rpm and call out, (for example) "rotor rpm in the low green." the airspeed may be adjusted between 0 and 55 knots as required, in order to reach a suitable landing or touchdown area.

(7) When it becomes apparent that the selected area may be reached, close the throttle to the FULL OFF position and state, "throttle off."

<u>NOTE</u>: The throttle FULL OFF position will only be used if an actual touchdown is anticipated. For student training where touchdown forced landings are prohibited, leave throttle adjusted to 2300 rpm.

c. <u>Responsibility for making a recovery from a forced landing</u>.

(1) Upon being given a simulated forced landing, the student must assume that he has experienced a loss of power and act accordingly. His responsibility is to get the aircraft safely on the ground by establishing a planned

autorotative descent to a suitable area and accomplishing a smooth touchdown commensurate with terrain.

(2) The decision for making a touchdown rests with the instructor pilot, but the student will plan each forced landing as if continuing to the ground. Prior to reaching 100 feet (AGL), the instructor will state one of three commands: "POWER RECOVERY," "TERMINATE WITH POWER," or "TOUCHDOWN."

NOTE: The commands, "TERMINATE WITH POWER" or "TOUCHDOWN" are used only when local regulations permit touchdowns or termination with power from simulated forced landings.

(a) Power recovery.

1. Used under situation when the instructor elects to discontinue an autorotative descent.

2. Recovery is initiated immediately following the instructor pilot's spoken command of "POWER RECOVERY."

3. May be ordered at any time after entering autorotation, but MUST be given at an altitude that will enable the student to return to normal operating rpm and be completely recovered prior to passing below 100 feet above the ground.

4. Upon receiving the command, "POWER RECOVERY," the student will immediately establish normal operating rpm

while simultaneously maintaining proper trim of the helicopter with antitorque pedals. When the power has been regained, sufficient collective pitch and throttle will be applied to establish a normal climb.

(b) Termination with power.

1. Used during situation when the instructor pilot elects NOT to make an autorotative touchdown, but desires that the student continue an autorotative approach to the desired touchdown area before recovering.

2. May be ordered at any time after entering the autorotative descent, but must be given at an altitude that will enable the student to apply operating rpm prior to passing through 100 feet above the ground.

3. Upon receiving the command, "TERMINATE WITH POWER," the student will continue the autorotative descent; however, prior to reaching 100 feet AGL, he will establish normal engine rpm (3100), trim the aircraft with pedal, and remain in autorotation. During the final portion of the approach, sufficient power and collective pitch will be applied to decrease the rate of descent to zero, while maintaining operating rpm at an altitude of 3 to 5 feet above the ground with the helicopter in a landing attitude. Speed at this point should be the same as if an actual touchdown were to be accomplished. Proper trim of the aircraft will be maintained throughout the maneuver by use of pedals. An altitude of 3 to 5 feet will be maintained until the aircraft is brought to a stationary hover.

d. Practice forced landing from a hover.

(1) A practice forced landing from a hover will be initiated by the instructor pilot with a reduction of throttle to the FULL OFF position.

(2) The student will immediately apply sufficient right pedal to maintain directional control and conserve rotor energy by leaving the collective pitch STATIONARY.

(3) At approximately 1 foot above the ground, and while keeping the skids level and parallel to the direction of movement, the student will apply remaining collective pitch to cushion the landing.

(4) After ground contact and all forward motion has ceased, the student will smoothly lower the collective pitch to the FULL DOWN position with the helicopter resting firmly on the ground.

(5) The student will then apply cyclic to level the rotor system.

e. Night forced landing procedure.

(1) The instructor pilot initiates a practice forced landing at night by a reduction of throttle.

(2) The student immediately lowers the collective pitch to the FULL DOWN position, while simultaneously applying sufficient right pedal to trim the aircraft, switches ON the landing light, and continues in autorotative descent as in a normal forced landing procedure.

(3) As soon as the aircraft is safely established in autorotative descent (minimum rotor rpm requirements are met), the instructor pilot will give the command, "POWER RECOVERY."

(4) The instructor pilot will INSURE that the student completes the recovery NO LOWER THAN 200 FEET above the ground.

20. MAXIMUM PERFORMANCE TAKEOFF

a. Required.

(1) 90° clearing turn completed prior to beginning maneuver.

(2) Pretakeoff check completed.

(3) High-speed magneto check completed.

(4) Clear left, right, and overhead prior to takeoff.

(5) Constant heading and ground track.

(6) Until clear of barrier (or 100 feet during practice), use a 25-knot attitude.

b. Analysis of maneuver. Place the cyclic and antitorque pedals in a neutral position, then slowly increase collective pitch. As the helicopter leaves the ground, maintain a 25-knot attitude with cyclic, continue to advance the throttle to the FULL ON position, and maintain constant heading with antitorque pedals. Once maximum power has been reached, rpm is controlled with collective pitch. Coordinate cyclic to maintain the 25-knot attitude until reaching 100 feet. Upon reaching 100 feet (or when the barrier is cleared), progressively accelerate to normal climb and adjust power to maintain normal climb, and trim the aircraft with pedals to maintain a constant ground track.

NOTE: Rpm must be controlled with collective pitch until the throttle is reduced sufficiently to regain direct throttle control of engine rpm.

21. STEEP APPROACH

a. Required.

(1) Approach angle - 20°.

(2) Entry altitude - as directed.

(3) Entry airspeed - 40 knots.

b. Analysis of maneuver.

(1) Initiate the steep approach as in the normal approach, maintaining a steeper angle of descent.

(2) Control approach angle with collective pitch and apparent groundspeed with cyclic.

(3) Maintain the entry airspeed until such time as apparent groundspeed and rate of closure appear to be increasing. From this point, progressively decrease the rate of descent and forward speed to stop both descent and forward movement at the intended landing spot. As forward

speed is gradually reduced, apply additional collective pitch to compensate for the decrease in translational lift and to maintain the proper angle of descent.

(4) Terminate the steep approach at a hover or to the ground in the same manner as the normal approach.

22. RUNNING TAKEOFF

a. Required.

(1) Restriction to less than hovering power.

(2) Constant heading.

(3) Altitude of 5 feet OR LESS during acceleration to 40 knots.

b. Analysis of maneuver.

(1) Establish and maintain 3100 engine rpm and apply sufficient collective pitch to cause the helicopter to become "light on the skids," but do not become airborne. The manifold pressure while in this condition represents the maximum power available for training purposes. Lower the collective pitch to the FULL DOWN position.

(2) Place the cyclic forward of neutral and smoothly apply collective pitch. The helicopter should start moving forward at less than maximum allowable power; if not, "rock" the pedals slightly to "break" the skids loose and facilitate the initial forward movement. As the helicopter

accelerates and translational lift is reached, aft cyclic will be required to accomplish a smooth lift-off with little or no pitching tendency and a minimum ground run.

NOTE: Maximum power allowable should be used (but not exceeded) in order to minimize the ground run.

(3) When airborne, accelerate to 40 knots at an altitude NOT to exceed 5 feet. When 40 knots has been reached, execute a gradual cyclic climb to an altitude of 50 feet; then, assume a normal climb and adjust power to climb power setting.

NOTE: During initial takeoff, if the helicopter rises on the toes of the skids prior to start of forward movement, insufficient forward cyclic is being used. Likewise, if the nose tends to tuck-under during acceleration, too much forward cyclic is being used.

23. RUNNING LANDING

a. Requirements.

(1) 5° to 12° approach angle.

(2) Entry altitude - as directed.

(3) Entry airspeed - 40 knots.

(4) Smooth surface commensurate with required ground run.

(5) Translational lift at touchdown.

b. Analysis of maneuver.

(1) The approach is initiated in the same manner as the normal approach, with the exception that a more shallow angle of descent is maintained. The power reduction to initiate the desired angle of descent will be commensurate with the angle of descent, density altitude, wind velocity, and load.

(2) During the approach, corrections for deviations from the desired line of descent should be made by the proper application of collective pitch.

(3) The initial airspeed (40 knots) should be maintained until reaching an altitude from which a deceleration can be made which will result in a touchdown with minimum forward speed, but still within effective translational lift.

(4) Prior to making contact with the ground on the final part of the approach, the helicopter is placed in a straight-and-level flight attitude by properly applying antitorque pedal, cyclic, and collective pitch, respectively. The panel represents the beginning of the usable landing area; touchdown must be on or slightly beyond this point. Pedals are used to maintain heading and after ground contact, the cyclic is held slightly forward of neutral. Normally, the collective pitch may be lowered for braking action. To insure directional control, 3100 rpm must be maintained until the helicopter has stopped.

24. RPM CONTROL

a. Required.

(1) Airspeed - 40 knots (slow cruise) or 55 knots (normal cruise).

(2) Altitude - 500 feet above ground level.

b. Analysis of maneuver.

(1) Rpm control while reducing collective pitch.

(a) Reduce manifold pressure with collective pitch while cross-checking rpm gauge.

(b) If rpm is slightly high, make the next inch manifold pressure reduction with throttle.

(c) Reduce manifold pressure steadily with pitch and/or throttle in 1-inch increments so as to maintain the desired rpm.

NOTE: Keep the manifold pressure needle moving in peripheral vision and rpm gauge in constant cross-check.

(d) Upon reaching the desired manifold pressure for steady state descent, make further corrections to rpm as in (a) above.

(2) Rpm control while increasing collective pitch.

(a) Increase manifold pressure with collective pitch while cross-checking rpm gauge.

(b) If rpm is slightly low, make the next inch manifold pressure increase with throttle.

(c) Increase manifold pressure steadily with pitch and/or throttle in 1-inch increments so as to maintain the desired rpm.

NOTE: Keep the manifold pressure needle moving in peripheral vision and rpm gauge in constant cross-check.

(d) Upon reaching the desired manifold pressure for steady state climb, make further corrections to rpm as in (a) above.

25. RECONNAISSANCE

a. General application.

(1) A high and a low reconnaissance is required before landing in any area without an established traffic pattern.

(2) A ground reconnaissance is required before maneuvering the helicopter on the ground or at a hover.

b. High reconnaissance.

(1) Required.

(a) Good vantage position for observation of area.

(b) Airspeed - 40 knots (slow cruise).

(2) Purposes.

(a) To determine suitability of the landing area.

(b) To locate barriers and estimate their effect on the wind.

(c) To select a point for touchdown and to plan the approach.

(d) To plan the flightpath for takeoff.

(3) Planning and execution. Upon approaching the area, make an overall evaluation of the area and the surrounding terrain to select the flightpath for the high reconnaissance. The altitude and pattern for the high reconnaissance will be governed by the terrain and availability of suitable forced landing area. It should be low enough to permit study of the general area; high enough to afford a reasonable chance of making a successful forced landing in an emergency; yet, not so high nor so distant as to prevent adequate study of the proposed landing area.

c. Low reconnaissance. Conduct the low reconnaissance and the approach together. When the approach is sufficiently near the proposed area for the pilot to study the area in detail and to distinguish small objects on the ground, the approach then becomes a low reconnaissance. As the pilot approaches, he continues to study the immediate vicinity of his selected touchdown point. If successful completion of the landing is in doubt, a go-around must be accomplished before loss of effective translational lift, or prior to passing below the barriers, whichever occurs first.

NOTE: Never land in an area from which a takeoff cannot be made.

d. Ground reconnaissance.

(1) Purpose. A ground reconnaissance is performed after landing to determine the suitability of the area for ground operations and to supplement the information of the high and low reconnaissance in determining a positive plan of action for executing the takeoff and climbout. A walking reconnaissance of the area can be performed if necessary, but normally, it is accomplished from the cockpit.

(2) Planning and execution.

(a) Some situations make it necessary to move the helicopter from the point of landing to another position for takeoff. Determine the takeoff plan by evaluating surface wind, height of barriers, obstructions in the area, shape of the cleared portion of the area, and any other factor which may be used or is applicable.

(b) After the plan for takeoff has been formulated, select an accessible route to the takeoff position. (Clearance between the aircraft and existing obstacles must be adequate at all points along the path of movement.) Plan each hovering turn with due consideration for the wide arc made by the antitorque tail rotor as the helicopter is pivoted on the horizontal plane.

26. CONFINED-AREA OPERATIONS

a. Definition. As used here, a confined area is any area where the flight of the helicopter is limited in some way by the presence of obstructions, natural or manmade.

b. Elements included in operation.

(1) High reconnaissance.

(2) Normal to steep approach into specified area.

(3) Low reconnaissance.

(4) Ground reconnaissance.

(5) Maximum performance takeoff from the area.

(6) Clear left, right, and overhead prior to takeoff.

(7) Accomplish a high-speed magneto check prior to takeoff.

c. Execution.

(1) Approach.

(a) During the high reconnaissance, plan the approach by taking into consideration several different and sometimes conflicting factors. Account for wind, and the best possible advantage to be obtained from it. Consider the height of barriers, finding the point's lowest obstruction—the most desirable point of entry into the area under favorable wind conditions. Where possible, plan flightpath to place the helicopter within reach of those areas most favorable for a forced landing.

(b) Mentally divide the area into three equal parts oriented along the planned approach path. Select the point of touchdown in the most forward usable third of the area (as viewed on the final approach leg). The touchdown point must be in sight prior to beginning the final approach descent.

(c) The angle of descent should be steep enough to permit clearance of the barrier, but never greater than a steep approach (20°).

(d) Terminate the approach on the ground when surface conditions permit.

(2) Low reconnaissance. Perform the low reconnaissance on the final leg of the approach.

(3) Ground reconnaissance. Before the helicopter is operated within the area, make a thorough ground reconnaissance to determine suitability and size of the area.

(4) Takeoff.

(a) For takeoff over a barrier, it may be necessary to move the helicopter away from the barrier to the maximum distance permitted by surrounding obstacles.

(b) Use the amount of power necessary to clear the barrier and maintain a constant angle of climb. (Clearing the barrier by a narrow margin with a reserve of power is more desirable than clearing the barrier by a wide margin but using maximum available power.)

27. PINNACLE AND RIDGELINE OPERATIONS

a. Definition. A pinnacle is an area from which the ground drops away steeply on all sides. A ridgeline is an area from which the ground drops away steeply on one or two sides, such as a bluff or precipice.

b. Required elements of operation.

(1) High reconnaissance.

(2) Normal approach.

(3) Low reconnaissance.

(4) "Airspeed over altitude" type takeoff.

(5) Clear left, right, and overhead prior to takeoff.

(6) Accomplish a high-speed magneto check prior to takeoff.

NOTE: Although a normal approach is established as standard, variance between a shallow-to-steep approach angle may be used, taking into consideration the wind velocity, density altitude, load, and available forced-landing areas.

c. Execution.

(1) Execute the climb to approach entry altitude for a pinnacle or ridgeline on the windward side of the area, when practicable, so that advantage may be taken of the created updraft.

Terminate approach to the ground unless terrain features are unsuitable for touchdown.

(2) Terminate an approach to a pinnacle or ridgeline with the point of touchdown well forward on the area to avoid the region of severe turbulence on the upwind end and the downdraft on the downwind end. (The low reconnaissance must be thorough and positive, so that the approach can be aborted, if necessary, before the aircraft is committed to the landing.) Exercise extreme caution during touchdown on uneven or rough terrain. Place skids "lightly" on the ground while maintaining sufficient collective pitch to keep the aircraft light on the skids. Check security of the helicopter as the collective pitch is slowly lowered; then, when satisfied that the helicopter is resting firmly on the ground, continue to depress the collective pitch, completing the landing, and level the rotor system.

(3) Ground movement of the helicopter is seldom necessary; however, if required -- proceed as described in paragraph 26d. Takeoff is generally made from the forward portion of the area.

(4) An "airspeed over altitude" type takeoff is made because the area is higher than the surrounding ground. Gaining altitude on takeoff is of secondary importance to that of gaining a safe airspeed. In addition to covering the unsafe ground quickly, a higher airspeed will afford a more favorable glide angle and, thus, contribute to the chances of reaching a suitable area or, if no area is available, of executing a flare successfully and reducing forward speed prior to landing in event of an engine failure.

28. SLOPE OPERATIONS

a. General. Practice slope operations develop pilot proficiency for performing operations on inclined surfaces. A slope landing may often be necessary during confined-area operations or during pinnacle and ridgeline operations.

b. Execution.

(1) The approach to a slope differs in no way from the approach to any other landing area; however, allowance must be made for wind, barriers, and suitable forced landing sites. Since the slope will almost always constitute an obstruction to wind passage, some turbulence and downdrafts should be anticipated.

(2) Slope landings 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 the reduction of collective pitch with lateral cyclic (into the slope) until the downslope skid touches the ground. Continue coordinating the reduction of the collective pitch and application of cyclic into the slope until all the weight of the helicopter is resting firmly on the slope. If the cyclic contacts the stop before the downslope skid is resting firmly on the ground, DO NOT CONTINUE TO LOWER THE COLLECTIVE PITCH but slowly return the helicopter to a hover by displacing the cyclic downslope and increasing the collective pitch. Select a position where the degree of slope is not so great. After completing the slope landing and after determining that the aircraft will maintain its position on the slope, place the cyclic in the NEUTRAL position.

NOTE: The cyclic is placed in the NEUTRAL position after completion of the landing to allow safe "HEAD CLEARANCE" on the upslope side of the helicopter.

(3) The takeoff technique is the reverse of the landing. Apply lateral cyclic into the slope; apply collective pitch to raise the downslope skid first. Coordinate lateral cyclic and collective pitch to bring the helicopter to a level attitude with the upslope skid still on the ground. After attaining a level attitude, continue increasing collective pitch to bring the helicopter to a hover. Maintain directional control throughout the maneuver with antitorque pedals.

PART II. EMERGENCY PROCEDURES AND CRITICAL CONDITIONS

29. ENGINE FAILURE AND/OR PARTIAL POWER LOSS

The altitude and airspeed at which the failure occurs dictates the action to be taken to effect a safe landing.

a. Engine failure during takeoff and while hovering below 10 feet.

(1) Collective pitch - MAINTAIN and permit helicopter to settle.

(2) Rotor energy - UTILIZE, by application of collective pitch just prior to ground contact, to cushion the landing.

(3) Skids - LEVEL and PARALLEL in direction of movement.

(4) Battery switch - OFF.

(5) Mixture lever - IDLE CUTOFF.

(6) Fuel shutoff valve knob - PULL OUT.

b. After landing, do not attempt to restart engine.

NOTE: If the collective pitch is increased prematurely when the engine fails, a loss in altitude will be delayed, ultimately resulting in insufficient rotor rpm to cushion the landing.

c. Engine failure between 10 and 400 feet. To reduce the possibility of a hard landing in the event of an engine failure, vertical climb between 10 and 400 feet (AGL) is not recommended. If engine failure occurs between 10 and 400 feet:

(1) Collective pitch - rapidly REDUCE an amount proportional to the altitude. At an altitude of 400 feet, REDUCE collective pitch to the FULL DOWN position. At an altitude of 10 feet, REDUCE collective pitch a slight amount. At intermediate altitudes, REDUCE collective pitch proportionately. (Rpm available at pitch-pull altitude will vary, depending on airspeed and altitude at time of engine failure.)

(2) Airspeed - OBTAIN forward speed, to reduce rate of descent, if altitude permits.

(3) Battery switch - OFF.

(4) Mixture lever - IDLE CUTOFF.

(5) Collective pitch - apply all available collective pitch to cushion touchdown. Time the application of collective pitch in proportion to rate of descent and the amount of available rotor rpm.

(6) Ignition switch - OFF.

(7) Shoulder harness - LOCK.

NOTE: When anticipating a forced landing—and time permitting—locking of the shoulder harness provides an added safety precaution over that of the automatic "three-G locking device"; however, when locked, this prevents the pilot from bending forward to reach all switches on the console. Therefore, all switches should be moved before the shoulder harness handle is manually moved to the locked position.

d. Engine failure during flight. Instantly execute an autorotative descent and landing as outlined in paragraph 17, section I. If time and altitude permit, accomplish the following:

(1) Mixture lever - IDLE CUTOFF.

(2) Battery switch - OFF.

(3) Ignition switch - OFF.

(4) Fuel shutoff valve knob - PULL OUT.

(5) Shoulder harness - LOCK.

NOTE: After landing, do not attempt to restart engine.

e. Partial power loss. Under partial power conditions, the engine may operate relatively smoothly at reduced power or it may operate roughly and erratically with intermittent surges of power. In instances when a power loss is experienced WITHOUT accompanying engine roughness or surging, the helicopter may sometimes be flown in a gradual descent at reduced power to a favorable landing area; however, under these conditions,the pilot should always be prepared for a complete power failure and an immediate autorotative landing.

(1) In the event that a partial power condition IS accompanied by engine roughness, erratic operation, or power surging, take immediate action by closing the throttle to the FULL OFF position and perform an autorotative landing to the nearest possible landing area.

(2) To prevent a sudden and hazardous yaw in case the engine should recover power, take care to keep the throttle in the FULL OFF position.

30. TAIL ROTOR FAILURE

a. Tail rotor failure during takeoff and while hovering below 10 feet. Close throttle immediately and accomplish an autorotational landing.

b. Tail rotor failure during flight. A failure in the tail rotor system will be evident by a loss of heading control which is primarily caused by engine torque. To reduce the engine torque to a minimum, the throttle should be closed immediately, collective pitch reduced to the FULL DOWN position, shoulder harness locked, and an autorotative glide established. The autorotative landing is completed as outlined in paragraph 17, section I, with these additions:

(1) Conditions permitting, it is most desirable to touch down from an autorotative landing at a forward speed of 14 to 18 knots (effective translational lift).

(2) Should a destructive impact appear imminent, use of the throttle to manipulate directional control may be used.

31. ENGINE FIRE

a. During starting.

(1) Starter - DEPRESS to continue engine cranking.

(2) IF engine does not start and fire is not ingested:

(a) Mixture lever - IDLE CUTOFF.

(b) Fuel shutoff valve knob - PULL OUT.

(c) Ignition switch - OFF.

(d) Battery switch - OFF.

b. During flight. If an engine fire is encountered during flight, immediately enter autorotation and prepare for a power-off landing and accomplish the following:

(1) Fuel shutoff valve knob - PULL OUT.

(2) Mixture lever - IDLE CUTOFF.

(3) Ignition switch - OFF.

(4) Battery switch - OFF.

(5) Shoulder harness - LOCK.

(6) Landing - execute an autorotative landing as outlined in paragraph 17, section I.

NOTE: Do not attempt to restart engine.

32. ELECTRICAL SYSTEM FAILURE AND/OR FIRE

Complete failure of the electrical system is improbable because primary D.C. power will be supplied by the battery in the event the generator fails; however, any nonessential electrical equipment should be turned off to conserve battery power. Monitor loadmeter to ascertain type of failure being experienced. If an electrical failure occurs, proceed as follows:

a. Battery and generator switches - OFF.

b. Accomplish a normal landing as soon as practicable, and have maintenance personnel investigate.

33. HYDRAULIC SYSTEM FAILURE

Hydraulic system failure can be detected by feedback forces becoming evident in the cyclic. The severity of these forces will be proportional, in intensity, to the airspeed, gross weight, and climatic turbulence. If servo failure occurs, accomplish the following:

a. Hydraulic boost valve knob - PULL UP.

b. Airspeed - REDUCE to 40 knots (slow cruise).

c. Landing - accomplish as soon as practical.

NOTE: Feedback forces are decreased with engine power reduction and are negligible in autorotation. Minimum engine power is required at an airspeed of approximately 40 knots (slow cruise). Execute a shallow approach and running landing when possible.

34. CYCLIC CONTROLS MALFUNCTION

a. Cyclic friction device - OFF.

b. Hydraulic boost valve knob - PULL UP.

c. Cyclic - break loose the jammed control boost cylinder by exerting pressure.

d. Airspeed - REDUCE to 40 knots (slow cruise).

e. Landing - accomplish as soon as practical.

35. VIBRATIONS

If ANY unusual vibration is encountered (vertical, lateral, or high-frequency), land as soon as practicable and request inspection of aircraft by maintenance personnel.

36. ABORTING A TAKEOFF FROM A CONFINED AREA (demonstration only)

a. General. The decision to abort the takeoff will be made as soon as either of two conditions become apparent: loss of rotor rpm (below green arc) and/or the helicopter is settling below the desired angle to clear the barrier.

b. Execution. Once the decision is made to abort the takeoff, the following procedures will be accomplished:

(1) Apply a sufficient amount of aft cyclic to stop forward movement.

(2) Lower collective pitch sufficiently to allow the helicopter to descend vertically in a skid level attitude.

(3) Maintain throttle FULL OPEN until rotor rpm increases into the green arc and at that time, DECREASE throttle to maintain operating engine rpm.

(4) If terrain is suitable, touchdown in a skid level attitude; if not, terminate in a low hover.

37. SETTLING WITH POWER

a. Description of the condition. Settling with power normally occurs when forward speed is less than 10 knots, altitude is in excess of design hovering altitude and 20 percent to 100 percent of available power is being applied. It is most likely to be encountered during the last one-third or short final of the steep approach and should be anticipated to occur during confined-area operations. The exactness of hovering capability is usually unknown due to density altitude, uneven terrain, direction of wind,and a broad range of variables which would require the use of additional power. The continuance of this condition from altitudes above the design hovering altitude will most likely result in a hard landing and the extent will largely be governed by the rate of descent; which, if not corrected, should increase to 300 feet per minute and above.

b. Correcting the condition. RELAX the back pressure on the cyclic and obtain an attitude which will achieve forward flight and return the helicopter to a favorable flight condition.

CAUTION

The airframe is in a critical flight position and control response is sluggish during the actual phenomenon of "settling with power." Therefore, smoothness in control touch is required to regain forward speed. At no time during the "settling with power" condition, should additional collective pitch be applied. Additional collective pitch will greatly aggravate the condition and near uncontrollable flight may be encountered.

BELL 47-6-4A

N 6241N

V-47 1st ship

N4004G 2nd ship

ENGINE VO-540-B1B3

IDLE 1500-1700 RPM

OPERATING 3000-3200 RPM

MANIFOLD (MAX) 26.1 Hg.

OIL PRESSURE 65 (min.) - 85 (MAX) psi

OIL TEMP. 40°C (min) - 113°C (MAX)

CYLINDER HEAD TEMP. 100° (min.) 246° (MAX)

MAX A/S 105 MPH

TRANSMISSION TEMP. 40°C (min.) - 130°C (MAX.)

CARBURETOR AIR TEMP -30°C (min) - +54°C (MAX)

ROTOR TACH. 333 - 370 RPM (min.) (MAX.)

ENGINE TACH. 3000 - 3200 RPM (min.) (MAX.)

MANIFOLD PRESSURE 19.5 - 26.1 HG. (min.) (MAX.)

80/87 Fuel

USABLE FUEL 57 GALLONS

BHP - 3100 RPM
280hp