STANDARDIZATION
OF
HELICOPTER MANEUVERS GUIDE

UH-1 A,B,D, AND 540 SERIES

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UNITED STATES ARMY AVIATION SCHOOL

FORT RUCKER, ALABAMA

This document supersedes standardization guide dated August 1966.

Throughout all maneuvers, the use of forced stick trim will be optional.

Engine rpm for all maneuvers described herein will be 6400 rpm for the UH-1A model and 6600 rpm for the UH-1B, D, and 540 series.

Due to the configuration of the 540 series, climbs and descents should be made at 80 knots and normal cruise at 100 knots; however, for training purposes, the flight commander may teach a 60-knot climb and descent and an 80-knot cruise.

For amplification of the maneuvers contained herein, consult TM 1-260.

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UH-1A, B, D, AND 540 SERIES

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Section 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 full open with collective pitch full down. Adjust rpm with rpm increase-decrease switch. Place cyclic control in the neutral position. Increase collective pitch control 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 breaks ground, make minor corrections with cyclic control to insure a vertical ascent and apply antitorque pedals to maintain directional control. During ascent, maintain throttle full open.

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 control to maintain position over pivot point. Maintain altitude with collective pitch. Avoid abrupt antitorque 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) Flight path perpendicular to heading.

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

4. REARWARD FLIGHT

a. Required.

(1) Altitude at constant 3-foot hover.

(2) 90° clearing turn.

(3) Constant rate of movement (5-knot maximum).

(4) Flight path of 180° to heading.

b. Description of maneuver. Maintain direction of flight with cyclic control. Keep heading parallel to the ground track with pedals. Maintain altitude with collective pitch.

5. LANDING FROM 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 corrections with pedals and cyclic control to maintain hovering 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. Apply cyclic as necessary to level rotor system.

6. NORMAL TAKEOFF

a. Required.

(1) Pretakeoff check completed prior to beginning maneuver.

(2) Maintain constant heading.

(3) Execute 90° clearing turn prior to takeoff.

(4) When climb is established:

(a) Use 60-knot airspeed.

(b) Adjust power to establish the desired rate of climb under different load-and-density altitude conditions. The desired rate of climb is 500 fpm.

b. Analysis of maneuver.

(1) From a hover.

(a) From a normal hover at 3-foot altitude, apply forward cyclic pressure to accelerate smoothly into effective translational lift; maintain heading with antitorque pedals. Maintain hovering altitude with collective pitch until effective translational lift has been obtained and the ascent has begun. Then, smoothly apply cyclic to attain an attitude that will result in an increase of airspeed to 60 knots. Adjust power as required to establish the desired rate of climb.

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

(2) From the ground.

(a) Place cyclic control slightly forward of neutral. Simultaneously increase collective pitch, maintaining directional control with antitorque pedals. As the aircraft leaves the ground, accelerate forward at the minimum altitude commensurate with terrain and obstacles until effective translational lift is attained. (A shallow climb angle may be established at this time; however, this should not be done at the expense of airspeed.) Continue to accelerate until 60-knot airspeed is reached and establish the power setting required to effect the desired rate of climb. This maneuver may also be performed as a takeoff from a low hover.

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

(3) On the takeoff leg. On the takeoff leg below 50 feet, wind drift correction will be made by slipping the helicopter into the wind; above 50 feet, wind drift correction will be accomplished by crabbing the helicopter into the wind.

7. NORMAL APPROACH

a. Required.

(1) Approach angle - 8° to 10°.
(2) Entry altitude - as directed.
(3) Entry airspeed - 60 knots.

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 power to compensate for the decrease in translational lift and to maintain the proper angle of descent.

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

8. STRAIGHT-AND-LEVEL FLIGHT

a. Required.

(1) Maintain constant altitude.

(2) Constant airspeed of 80 knots.

(3) Constant ground track.

b. Analysis of maneuver.

(1) In straight-and-level flight, control attitude and airspeed with cyclic. Maintain altitude with the collective pitch control. Coordinate antitorque pedals with power changes to maintain a constant heading.

(2) To effect proper pedal trim, level helicopter laterally with cyclic control and apply antitorque pedal as required to center needle and ball of turn-and-bank slip indicator.

(3) In crosswind, maintain a straight ground track by crabbing the helicopter.

9. NORMAL CLIMB

a. Required.

(1) Maintain constant ground track.

(2) Constant airspeed of 60 knots.

(3) Rate of climb of 500 fpm.

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

10. NORMAL DESCENT

a. Required.

(1) Maintain constant ground track.

(2) Airspeed of 60 knots.

(3) Torque pressure to establish the desired rate of descent of 500 fpm.

b. Analysis of maneuver. Coordinate power, cyclic control, and antitorque pedals smoothly to maintain a constant ground track and to establish a 500 fpm rate of descent and a pitch attitude that will gradually decrease airspeed to 60 knots.

11. LEVEL TURNS

a. Required.

(1) Airspeed of 80 knots.

(2) Constant attitude and degree of bank.

b. Analysis of maneuver.

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

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

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

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

12. CLIMBING AND DESCENDING TURNS

a. Required.

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

(2) 500 fpm for climb.

(3) 500 fpm for descent.

(4) Airspeed of 60 knots.

b. Analysis of maneuver.

(1) A climbing or descending turn is normally accomplished with a more shallow bank than a level turn, since the radius of turn is lessened by the slower airspeed of 60 knots.

(2) From normal climb or normal descent, initiate the climbing or descending turn by applying lateral cyclic control coordinated with antitorque pedal 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 500 fpm climb and proper trim with antitorque pedals. Maintain 60-knot airspeed with cyclic control. (If power setting remains constant, no pedal change should be required once bank is established.)

(b) For a descending turn, maintain 500 fpm descent and maintain proper trim with antitorque pedals. Maintain 60-knot airspeed with cyclic control. (If power setting remains constant, no pedal change should be required once bank is established.)

(3) To return to a straight climb or descent from the turn, apply lateral cyclic control and sufficient antitorque pedal to trim the helicopter. Maintain proper torque pressure setting and 60-knot 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 control, and antitorque pedals is required to establish a banked 60-knot attitude.

(5) To establish straight-and-level flight from a climbing or descending turn, coordinate controls smoothly as in "(3) above."

13. BASIC AUTOROTATION

a. Required.

(1) Heading into wind or in the direction of traffic.

(2) Entry altitude as directed.

(3) Entry airspeed of 80 knots.

(4) Rotor speed of 285 to 314 rpm desired for A series (330 maximum); 294 to 324 rpm desired for B, D, and 540 series (339 maximum).

b. Analysis of maneuver.

(1) Entry altitude. From an assigned altitude (or traffic altitude) with airspeed of 80 knots, reduce collective pitch to maintain rotor rpm in the green and simultaneously roll throttle off to the flight idle detent. Maintain ground track by crabbing or slipping the helicopter (depending on the amount of crosswind). Adjust pitch as necessary to maintain rotor rpm in the green. Apply aft cyclic control pressure to effect a smooth deceleration to a 60-knot attitude. Maintain a 60-knot attitude and check rotor rpm and gas producer and call out (for example) "rotor in the low green, gas producer 60 percent."

(2) Final autorotative descent and termination.

(a) At 50 to 100 feet above the ground, assume a decelerating attitude by moving the cyclic control smoothly to the rear and insure alignment of the aircraft with the runway by proper application of antitorque pedals and cyclic control. Position collective pitch as desired to maintain rotor rpm within allowable limits. Visually recheck rotor rpm and gas producer during final portion of descent. (Care must be exercised in assuming the decelerating attitude so that the cyclic control is not moved rearward so abruptly as to cause the helicopter to climb.)

(b) At approximately 10 to 15 feet, apply sufficient collective pitch to slow the rate of descent, assist deceleration, and effect a smooth touchdown.

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

CAUTION

Do not lower collective pitch to provide braking action.

14. 180° AUTOROTATION

a. Required.

(1) Entry altitude - as directed.

(2) Entry airspeed - 80 knots.

(3) Rotor speed - 285 to 314 desired for A series (330 maximum); 294 to 324 desired for B and D series (339 maximum).

(4) During descent - 180° turn.

b. Analysis of maneuver.

(1) Entry. Reduce collective pitch to maintain rotor rpm in the green; simultaneously roll throttle off to the flight idle detent and trim aircraft. Apply aft cyclic control pressure to effect a smooth deceleration to a 60-knot attitude (maintain 80 knots in 540-series) and start a turn with coordination of cyclic control and pedal. Adjust degree of bank to insure rollout aligned with touchdown area. Maintain 60-knot attitude and check rotor rpm and gas producer and call out (for example) "rotor in the low green, gas producer 60 percent."

(2) Final autorotative descent and termination (same as basic autorotation).

15. HOVERING AUTOROTATION

The hovering autorotation is a practice maneuver designed to develop the reaction time and skill required to recover from an engine failure while hovering or during initial takeoff.

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 flight idle position. Simultaneously apply right pedal as required to maintain heading and apply cyclic control 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.

CAUTION

Because of the inherent lag (approximately 4 seconds) in turbine power acceleration from the flight idle position to normal operating rpm, caution must be exercised in the performance of practice autorotations where the termination is either a "power recovery" or "termination with power." The recovery must be initiated soon enough to preclude the possibility of a dangerous condition.

16. FORCED LANDING PROCEDURE

a. A practice forced landing is a simulated emergency situation designed to develop the student pilot's proficiency, reaction time, planning, and judgment in case of engine failure during flight. 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 maintain rotor rpm in the green while simultaneously applying right pedal as required to properly trim the aircraft.

(3) 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.

(4) Check rotor rpm and gas producer and call out (for example) "rotor in the low green, gas producer 60 percent." The airspeed may be adjusted between 0 and 80 knots as required in order to reach a suitable touchdown area.

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

c. Responsibility for making recovery from forced landing.

(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 accomplish 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 continuing to the ground. Prior to reaching 100 feet of altitude, the instructor will state one of three commands: "POWER RECOVERY," "TERMINATE WITH POWER," or "TOUCHDOWN."

(a) Power recovery.

1. Used under situations 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 prior to passing below 100 feet of altitude.

4. Upon receiving the command, "POWER RECOVERY," the student will immediately establish normal operating rpm while simultaneously maintaining proper trim of the aircraft with pedals. When the power has been regained, sufficient collective pitch will be applied to establish a normal climb.

(b) Termination with power.

1. Used during situations 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 autorotation, but must be given at an altitude that will enable the student to apply full power prior to passing through 100 feet of altitude.

3. Upon receiving the command, "TERMINATE WITH POWER," the student will continue the autorotative descent. Prior to reaching 100 feet, he will establish normal engine rpm, 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 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 effected. 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. Night forced landing procedure.

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

(2) Student immediately lowers the collective pitch to maintain rotor rpm in the green, while simultaneously applying sufficient antitorque pedal to trim the aircraft, switches on and adjusts landing and/or search light, and continues as in a normal forced landing procedure.

(3) As soon as the collective pitch is reduced sufficiently to maintain rotor rpm in the green, the instructor will rejoin the needles to full operating rpm, but not later than 400 feet above the ground.

(4) The instructor will insure the student recovers no lower that 100 feet above the ground.

17. TRAFFIC PATTERN

a. Required.

(1) Initial climb - 60 knots.

(2) Altitude - as directed.

(3) Airspeed - 80 knots.

b. Analysis of maneuver. After takeoff, climb straight ahead at 60 knots to 300 feet, turn on the crosswind leg, and continue to climb at 60 knots. (The downwind turn may be made as the crosswind turn is completed, after reaching traffic altitude, or started so that traffic altitude and 80 knots are reached as the turn is completed.) With due care for the helicopters being followed in the traffic pattern and for the spot of intended landing, turn on the base leg. Throughout the base leg, decrease the power required to lose altitude steadily while decreasing airspeed to 60 knots. Plan the turn from the base leg to approach leg to align the helicopter with the selected lane at 300 feet and 60 knots.

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) Above 50 feet on the approach leg, make wind drift correction by crabbing or slipping or a combination thereof. Below 50 feet, make wind drift correction by slipping helicopter into the wind. On the crosswind, downwind, and base legs, make wind drift correction by crabbing helicopter into the wind.

18. DECELERATIONS

a. Required.

(1) Entry airspeed - 80 knots.

(2) Minimum airspeed - 40 knots.

(3) Minimum altitude - 100 feet.

b. Analysis of maneuver.

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

(2) Use cyclic control to slowly decelerate, pedals to maintain directional control, and collective pitch to maintain altitude.

(3) As airspeed is decreased (not below 40 knots), compensate for loss of lift by applying collective pitch to maintain altitude. Apply forward cyclic and collective pitch as required to smoothly accelerate to entry speed.

19. MAXIMUM PERFORMANCE TAKEOFF

a. Required.

(1) Pretakeoff check completed prior to beginning maneuver.

(2) Constant heading and ground track.

(3) Until clear of barrier (or 100 feet during practice), use:

(a) 40-knot airspeed attitude.

(b) Gas producer (N_1) 3 percent above hover power, not to exceed "go-no-go" limits.

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

b. Analysis of maneuver. Place the cyclic control and antitorque pedals in a neutral position; then, slowly increase collective pitch. As the helicopter leaves the ground, continue to increase the collective pitch at a constant rate until maximum allowable N_1 is reached. Coordinate cyclic control and correlate antitorque pedals with power increase to insure the helicopter leaves the ground in a 40-knot attitude. Above 50 feet, crab the aircraft to maintain ground track. At an altitude of 100 feet or when the barrier is cleared, progressively increase airspeed and adjust power to establish a normal climb.

20. STEEP APPROACH

a. Required.

(1) Approach angle - 12° to 15°.

(2) Entry altitude - 300 feet or traffic altitude.

(3) Entry airspeed - 60 knots.

b. Analysis of maneuver.

(1) Initiate the steep approach as in the normal approach, maintaining a steeper angle of descent. (To initiate the descent, a greater reduction of collective pitch is usually required at the beginning of the approach.) Correct for deviations from the desired line of descent by proper application of collective pitch.

(2) 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 power to compensate for the decrease in translational lift and to maintain the proper angle of descent.

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

21. PRECISION AUTOROTATION

a. Required.

(1) Heading - into wind or direction of traffic.
(2) Entry altitude - as directed.
(3) Entry speed - 80 knots.
(4) Engine rpm - flight idle detent.
(5) Touchdown - on predetermined spot.

b. Analysis of maneuver. Five variables are at the disposal of the pilot to effect precision termination.

(1) The initial point of entry may be varied after estimating the angle of descent. Wind, load, and other influencing factors will be considered in determining the exact point to enter autorotation.

(2) During the initial descent, the airspeed can be varied to maintain a line of descent to the point two or three helicopter lengths short of the touchdown point.

(3) Rotor rpm may be varied from the minimum area of the green arc upward so as not to exceed the red line. Minimum rpm will cause the glide to be extended. Increased rpm will result in a shorter glide angle.

(4) The deceleration attitude may be varied to touchdown on a predetermined spot at the desired forward speed.

(5) The rate of application of collective pitch and the attitude of the helicopter may both be varied slightly to shorten or extend the final portion of the autorotative descent. To shorten the glide, a slightly tail-low attitude must be maintained, and application of collective pitch must be more positive to slow the helicopter. To lengthen the glide, the helicopter must be held in a more level attitude, and application of pitch must be more gradual to prevent dissipation of forward speed.

22. RECONNAISSANCE

a. General application.

(1) A high and low reconnaissance are 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) Constant airspeed of 60 to 80 knots.

(2) Purposes.

(a) To determine suitability of the landing area.

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

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

(d) To plan the flight path for takeoff.

(3) Planning and execution. Upon approaching the area, make an overall evaluation of the area and the surrounding terrain to select the flight path for the high reconnaissance. (The altitude and pattern for the high reconnaissance will be governed by the terrain and availability of 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 (normally). (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 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.) 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 reconnaissance and the 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 into position for takeoff from the point of landing.) Determine the takeoff plan by evaluating surface wind, height of barriers, obstructions in the area, the shape of the cleared portion of area, and any other factor that may apply.

(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 rotor as the helicopter is pivoted on the horizontal plane.

23. CONFINED AREA OPERATION

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) Gas producer N_1 not to exceed "go-no-go" limits.

(7) Clear left, right, and overhead 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 conditions and the best possible advantage to be obtained from them. 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 flight paths to place the helicopter within reach of those areas most favorable for a forced landing.

(b) Select the point of touchdown in the far third of the area. The touchdown point must be in sight prior to beginning 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.

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

(2) Low reconnaissance. Perform the low reconnaissance on the approach.

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

(4) Takeoff.

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

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

24. 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 (during approach).

(4) "Airspeed over altitude" takeoff.

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

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

c. Execution.

(1) Execute the climb to a pinnacle or ridgeline on windward side of area, when practicable, so that advantage may be taken of updraft. Terminate approach just clear of the ground unless density altitude or load conditions dictate a termination to the ground.

(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 at 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 ground while maintaining sufficient collective pitch to keep aircraft light on skids. Check security of helicopter as pitch is decreased. When satisfied that the helicopter is settling firmly on the ground, complete the landing.

(3) Ground movement of the helicopter is seldom necessary since takeoff is generally made from a forward portion of the area.

(4) An "airspeed over altitude" 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 high 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.

25. SLOPE OPERATION

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 material way from the approach to any other landing area. Allowance must be made for wind, barriers, and forced landing

sites. Since the slope will almost always constitute obstruction to wind passage, some turbulence and downdrafts must always 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 reduction of collective pitch with lateral cyclic (into the slope) until the downslope skid touches the ground. Continue coordinating reduction of the 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 a 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 in the neutral position.

Note. The cyclic is placed in the neutral position after landing to allow safe "head clearance" on the upslope side of the helicopter.

(3) The takeoff technique is the reverse of the landing technique. Apply lateral cyclic control into the slope. Apply collective pitch to raise the downslope skid first. Coordinate lateral cyclic control 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 aircraft to a hover. Maintain directional control throughout the maneuver with antitorque pedals.

26. LOAD OPERATIONS

Load operations are designed to simulate actual missions that the aircraft may be required to perform as part of its military capabilities. The helicopter will be loaded within center-of-gravity limitations and under maximum allowable gross weights in accordance with the Operator's Handbook.

a. Normal takeoff with loads (internal).

(1) Required.

(a) Pretakeoff check completed prior to beginning maneuver.

(b) Gas producer (N_1) not to exceed "go-no-go" limits at a 2-foot hover.

(c) Heading into wind or in direction of traffic.

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

(2) Analysis of maneuver. Place cyclic control slightly forward of neutral. Simultaneously increase collective pitch, maintaining directional control with antitorque pedals. As the aircraft leaves the ground, accelerate forward at the minimum altitude commensurate with terrain and obstacles until effective translational lift is attained. (A shallow climb angle may be established at this time; however, this should not be done at the expense of airspeed.) Continue to accelerate until 60-knot airspeed is reached and establish the power setting required to effect the desired rate of climb. This maneuver may also be performed as a takeoff from a low hover.

b. Normal approach with loads (internal).

(1) Required.

(a) Heading - into the wind or in direction of traffic.

(b) Entry altitude - as directed.

(c) Entry airspeed - 60 knots.

(d) Approach angle - approximately 8° to 10°.

(2) Analysis of maneuver. When 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 this intended landing spot. As forward speed is gradually reduced, apply additional power to compensate for decrease in translational lift and to maintain the proper angle of descent. Terminate approach to the ground if landing surface permits.

c. Takeoff with external loads.

(1) Required.

(a) Pretakeoff check completed prior to beginning maneuver.

(b) Vertical ascent until load clears the ground.

(c) Gas producer (N_1) not to exceed "go-no-go" limits with load 2 feet above ground.

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

(2) Description of maneuver. Hover over load. When load is attached, increase collective pitch, simultaneously maintaining rpm, if necessary, with rpm increase-decrease switch until load clears the ground. (Remainder of takeoff is performed as in "a(2) above.")

d. Approach with external loads.

(1) Required.

(a) Heading - into the wind or in direction of traffic.

(b) Altitude - as directed.

(c) Approach angle - 8° to 10°.

(d) Entry airspeed - 60 knots.

(2) Analysis of maneuver. When the proper angle is intercepted, decrease collective pitch to initiate approach. Adjust collective pitch to hold a constant angle of descent. Maintain entry airspeed until apparent groundspeed or rate of descent begins to increase. At this time, begin deceleration until reaching zero groundspeed at an altitude

which is just high enough for the load to clear the ground. (As airspeed is being dissipated toward the end of the approach, care must be exercised that sufficient collective pitch is maintained to slow the rate of descent and finally to stop the aircraft.) Reduce hovering altitude until weight of load is on the ground; then, release the load.

27. HIGH OVERHEAD APPROACH

a. Required.

(1) Entry altitude - 1,500 feet above terrain.

(2) Entry airspeed - 80 knots.

(3) Rate of descent - maximum 1,500 fpm.

(4) Rotor rpm - maintain within limits.

(5) Coordinated turn - maintained in descent.

(6) Final approach - into the wind or direction of traffic.

b. Analysis of maneuver. Lower the collective pitch to effect a maximum rate of descent (1,500 fpm). Establish an 80-knot attitude with cyclic and coordinate turn with proper application of antitorque pedals. While executing a series of coordinated descending turns, planning and judgment should be exercised to insure that final approach to the area is into the wind. Apply collective pitch and aft cyclic to slow the rate of descent to effect a deceleration for the last 200 feet of the approach. Maintain rotor rpm within the green arc with collective pitch. Termination of the approach will be the same as explained in confined area operations.

28. LOW-LEVEL AUTOROTATION

a. Required.

(1) Heading - into wind or in direction of traffic.

(2) Entry altitude - 50 feet.

(3) Entry airspeed - 80 knots (cruising).

(4) Rotor speed, arc - maximum 330 for A series; 339 for B, D, and 540 series.

b. Analysis of maneuver.

(1) In preparation for the low-level autorotation, start descent in turn from downwind leg of traffic, descending to an altitude of 300 feet on base leg. Downwind leg should be planned in such a way to enable continued descent while on final to the autorotative entry altitude of 50 feet.

(2) From an entry altitude of 50 feet (actual altitude) with airspeed of 80 knots, simultaneously lower collective pitch to maintain the rotor in the green arc. Roll throttle off to the flight idle detent, applying aft cyclic control pressure to effect a smooth deceleration to slow the forward groundspeed sufficiently to effect a minimum ground run.

(3) Final autorotative descent and termination (same as basic autorotation).

28-2. 180° AUTOROTATION (termination with power)

a. Required.

(1) Entry altitude - as directed.

(2) Entry airspeed - 80 knots.

(3) Rotor speed - 285 to 314 desired for A series (330 maximum); 294 to 324 desired for B and D series (339 maximum).

(4) During descent - 180° turn.

b. Analysis of maneuver.

(1) Entry. Reduce collective pitch to maintain rotor rpm in the green; simultaneously roll throttle off to the flight idle detent and trim aircraft. Apply aft cyclic control pressure to effect a smooth deceleration to 60 knots (maintain 80 knots in 540-series) and start a turn with coordination of cyclic control and pedal. Adjust degree of bank to insure rollout aligned with touchdown area. Maintain 60-knot attitude and make frequent visual checks of rotor rpm during descent (must be within the allowable limits). Pitch will be adjusted as necessary to maintain rotor rpm in the green.

(2) Termination. Prior to reaching 100 feet, the student will establish normal engine rpm, 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 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 effected. 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.

Section II. EMERGENCY PROCEDURES

29. ENGINE FAILURE

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

a. Engine failure while hovering. If engine fails at hovering altitude, the aircraft will settle. Hold collective pitch in the same position used while hovering. Apply right pedal to avoid a left turn while landing. Maintain position over spot with cyclic control. Just before ground contact, increase collective pitch to cushion landing. If engine failure occurs during initial part of takeoff, proceed as above but do not attempt to stop forward movement. Make touchdown as near a level attitude as possible.

b. Engine failure in flight. Accomplish autorotative landing as outlined in paragraph 21, section I. If time and altitude permit, turn off fuel and engine switches and lock shoulder harness prior to touchdown.

30. VIBRATIONS

Vibrations may occur upon entering autorotation. These vibrations are similar to ground resonance. If vibration is encountered, immediately make a power recovery. If vibration continues, turn off hydraulic power, if possible. After normal flight is recovered, return to base airfield and request inspection of aircraft. In order to minimize the probability of this type of vibration, there should be a minimum of "built-in" friction measured at the top of the collective control with the friction device full off. In addition, all UH-1 aircraft should be flown with a moderate amount of mechanical friction applied.

31. ENGINE FIRE DURING STARTING

a. If engine fire should develop while starting, the fire may be detected visually by the fireguard or by illumination of the fire detector warning light located on the instrument panel.

b. To extinguish the fire, proceed as follows:

(1) Hold on starter switch in an attempt to pick up gas producer turbine rpm. Monitor tailpipe temperature.

(2) If redline temperature is exceeded, or if engine does not start:

(a) Close throttle and continue cranking engine.

(b) Close fuel valve switch.

(c) Cut off fuel boost pump switch.

(d) Cut off battery switch.

32. FUEL SYSTEM FAILURES

Fuel system failures are divided into two types -- helicopter fuel system and engine fuel system failures.

a. Helicopter fuel system failure. Helicopter fuel system failure may be caused by the malfunction of the fuel boost pump. This failure is indicated by illumination of the master caution light and the fuel pressure light (UH-1A), left fuel boost, right fuel boost, or engine fuel pump lights (UH-1B, D, and 540) located on the caution panel. Proceed as follows:

(1) Descend to a pressure altitude of 5,000 feet or less.

Note. The engine fuel pump is capable of supplying engine fuel requirements at pressure altitudes of less than 5,000 feet.

(2) Check fuel boost pump switch - on.

(3) Check fuel valve switch - open.

(4) Check fuel and oil valves and fuel pump circuit breakers - in (UH-1A and B); fuel and fuel sump circuit breakers - in (UH-1D).

(5) Attempt, if necessary, an engine restart during flight in accordance with the following instructions:

(a) Establish autorotative glide for a minimum rate of descent.

(b) Retard throttle to flight idle detent.

(c) Put governor switch in emergency position.

(d) Check fuel boost pump switch - on.

(e) Check fuel valve switch - open.

(f) Check fuel pressure - 15 psi.

(g) Check battery and generator switches - on.

(h) Starter generator - start position.

(i) Depress starter ignition switch. Observe rpm increase to determine if engine has started.

(j) Release starter ignition switch in accordance with "Normal and Emergency Procedures" flip chart.

(k) If engine fails to start, proceed as in total engine failure.

WARNING

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

33. TORSION

At high power, an engine and power train tone change may be noted. This is caused by malfunction of the power turbine (N_2) governor and is usually followed by power turbine (N_2) oscillations and torque changes. To relieve this condition, reduce rpm with the throttle to a value 50 to 100 rpm less than the governing rpm to take control away from the governor. When the torsion condition dampens out, apply full throttle. If the condition does not dampen out, reduce throttle to the flight idle detent and enter autorotation momentarily (if altitude permits). Place governor switch in emergency; reapply throttle smoothly to 6200 rpm (UH-1A); 6400 rpm (UH-1B and D).

34. HYDRAULIC POWER FAILURE

Hydraulic power failure is not generally apparent until a control movement is executed or the aviator sees the master caution panel lights. The forces required to initiate movement of the controls are increased and moderate feedback will be felt through the controls.

The aircraft can be flown with the hydraulic power inoperative. In the event of hydraulic failure, the procedures to follow are listed below:

a. Check hydraulic circuit breakers - in.

b. Check hydraulic control switch - on; off - if power is not restored.

c. Airspeed should be adjusted to a comfortable control movement level (60 to 70 knots).

d. Maintain desired heading and altitude.

e. Reset master caution light.

f. Contact a control agency and advise the agency of hydraulic failure.

g. Land as soon as practical (generally the nearest airfield or an area suitable for a running landing).

h. The approach should be shallow (5° to 8° angle). Maintain entry airspeed (60 knots) until such time as apparent groundspeed and rate of closure appear to be increasing. From this point, progressively decrease rate of descent and forward speed to facilitate a touchdown at or near effective translational lift speed. During touchdown, maintain directional control with cyclic and heading with antitorque pedals. After ground contact is established, slowly decrease collective pitch to minimize forward speed. Position cyclic as necessary to level rotor system. If braking action is desired, the collective pitch may be lowered as required for quicker stopping.

35. SIMULATED GOVERNOR FAILURE

The following procedures apply for instruction in governor failure operations:

a. High-side failure (oral only). Increase collective pitch immediately to "load" the rotor system and prevent engine/rotor overspeed, while simultaneously reducing throttle from the full-open position to a point where manual control is gained. Adjust power and rpm manually. Do not move the governor switch into the "EMER" position since this serves no useful purpose than to by-pass the automatic unit (from which the pilot has already taken control, manually). Under these conditions, the pilot is not required to closely monitor N_1 or EGT during acceleration, deceleration, or constant-speed operations since there is no possibility of accelerating or decelerating the engine too rapidly and the control will automatically maintain whatever N_1 the pilot requests through the twist grip. The pilot must constantly monitor N_2 to maintain desired engine/rotor rpm.

b. Low-side failure (on the ground/at a hover).

(1) While on the ground, the instructor will reduce the throttle until an indication of a power reduction is apparent, (suggested 6000 rpm); then move the governor switch to the EMERGENCY position. A further reduction of N_1 should be noted and the rpm should then be increased manually with the throttle. All throttle adjustments should be made smoothly to preclude flameout, compressor stall, or engine overtemp/overspeed. The N_2 rpm should be stabilized at or slightly below operating rpm and the instructor must stress the precautions to be taken when applying pitch and throttle without the correlation device.

(2) The student will practice throttle control on the ground and during hovering flight. The instructor will closely monitor N_1, N_2, and EGT during ground and hovering operations. To reestablish AUTO governor from the EMERGENCY position, land the helicopter, synchronize the rpm manually to the same rpm at which the governor was last adjusted (beeped), return the switch to the AUTO position, and advance the throttle manually to the full-open position.

c. Low-side failure - in-flight.

(1) Practice in-flight procedures will be conducted in the traffic pattern and initiated on the downwind leg.

(2) When on the downwind leg, the governor increase-decrease switch will be activated to the full-increase position (full beep) and the throttle subsequently reduced manually to maintain operating rpm. The governor switch will remain in the AUTO position. The aircraft will then be flown through a completed normal approach and landing. To reestablish normal operating rpm, increase the throttle to the full-open position manually and beep the rpm down to that desired.