Romero

STANDARDIZATION

OF

HELICOPTER MANEUVERS

TH-13T

CONTACT AND BASIC INSTRUMENTS

IRONIRON

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DEPARTMENT OF ROTARY WING TRAINING

UNITED STATES ARMY AVIATION SCHOOL

FORT RUCKER, ALABAMA

CUT ON LINE TO FIT TM 1500-1 INSERT

NOTES

1. Engine rpm for all "power-on" maneuvers, except takeoff and landing, will be 3100; for takeoff and landing, maintain 3200.

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

3. Emphasis should be placed on practice of autorotations with hydraulic power turned off. This realistically simulates the conditions resulting from actual engine failure.

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THE FOLLOWING POWER LIMITATIONS WILL BE ADHERED TO:

MANIFOLD PRESSURE TABLE (inches of mercury)
MAXIMUM TAKEOFF POWER/CLIMB POWER: MAP 270 hp for 2 minutes; a lesser hp in excess of 220 hp may be used for 5 minutes:
A combination of the two power settings will not exceed 5 minutes; i.e., 2-minute MAP, 3-minute climb power, total 5 minutes.

F. A. T.	M. P.
-5°C	31.2
+5°C	32.0
+15°C	32.8
+25°C	33.6
+35°C	34.4
+45°C	35.2

MAXIMUM ALLOWABLE INCHES OF MERCURY
For continued operation (220 hp)

F. A. T.	M. P.
15°C	26.7
20°C	26.9
25°C	27.1
30°C	27.3
35°C	27.5
40°C	27.7
45°C	27.9
50°C	28.1

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PART I. CONTACT 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 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 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 counter-pressure on pedals to maintain constant rate of turn. Coordinate cyclic control to maintain position over pivot point. Maintain altitude and rpm with collective pitch and throttle. Avoid abrupt antitorque pedal movements.

3. 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.

4. NORMAL TAKEOFF

a. Required.

(1) Pretakeoff check completed prior to beginning maneuver.

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

(3) Maintain constant track.

(4) When climb is established:

(a) 50-knot airspeed.

(b) Takeoff manifold pressure. Maximum allowable power (MAP) 270 hp (not to exceed 2 minutes).

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, and 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 normal climb.

(b) Stabilize airspeed and manifold pressure, sufficient for 500-fpm rate of climb (not to exceed 270 hp), as quickly as a smooth rate of acceleration will permit.

(2) From the ground.

(a) Place cyclic slightly forward of neutral. At the same time, gradually increase pitch, maintaining directional control with antitorque pedals. As the aircraft leaves the ground, accelerate forward in order to arrive at hovering altitude when effective translational lift is obtained and the ascent has begun. Smoothly apply forward cyclic to attain an attitude that will result in an increase of airspeed to normal climb.

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

(3) Wind drift correction. 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.

5. NORMAL APPROACH

a. Required.

(1) Prelanding check - complete.

(2) Approach angle - 12°.

(3) Entry altitude - as directed.

(4) 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 "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.

6. STRAIGHT-AND-LEVEL FLIGHT

a. Required.

(1) Maintain constant altitude.

(2) Constant airspeed of 60 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) In crosswind, maintain a straight ground track by crabbing the helicopter.

7. NORMAL CLIMB

a. Required.

(1) Maintain constant ground track.

(2) Constant airspeed of 50 knots.

(3) Manifold pressure sufficient for normal climb 500 fpm, not to exceed maximum for continuous operation.

b. Analysis of maneuver. Airspeed and attitude are controlled with the cyclic. Collective pitch and throttle are used to establish the desired rate of climb. Antitorque

pedals are coordinated with power changes to maintain constant heading.

8. NORMAL DESCENT

a. Required.

(1) Maintain constant ground track.

(2) Airspeed of 60 knots.

(3) Manifold pressure sufficient for normal descent 500 fpm (approximately 18").

b. Analysis of maneuver. Coordinate power, cyclic control, and antitorque pedals smoothly to maintain a constant ground track and to establish an appropriate rate of descent and an attitude that will gradually decrease airspeed to the required amount.

9. MAXIMUM PERFORMANCE TAKEOFF (ITO TYPE)

In order to facilitate training for the instrument TAKEOFF during the basic instrument phase, the maximum performance TAKEOFF will be executed as described, for instrument TAKEOFF with the exception that the maneuver is executed visually, without the hood. (See ITO, chapter 2, "Basic Instruments for Explanation of Maneuver.")

10. STANDARD AUTOROTATION

a. Required.

(1) Prelanding check - complete.

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

(3) Entry altitude - as directed.

(4) Entry airspeed - 60 knots.

(5) Rotor speed - within safe operating limitations.

b. Description of maneuver.

(1) Entry altitude. From an assigned entry altitude with required airspeed, reduce collective pitch to the FULL DOWN position. Maintain heading by proper application of antitorque pedals. (Establish engine rpm at 2300.) Maintain 60-knot attitude, and make frequent visual checks of rotor rpm and airspeed during descent (must be within the allowable limits).

(2) Final autorotative descent and termination.

(a) At approximately 100 feet above the ground, recheck rotor tachometer to insure that rotor rpm is within safe operating limits. Close throttle to OVERRIDE position, and indicate check by calling out "rotor rpm in the green, override." Assume an attitude which will slow apparent groundspeed to a fast hover at initial pitch-pull altitude. Collective pitch should remain in the FULL DOWN position unless required to prevent rotor overspeed.

(b) At approximately 10 to 15 feet, apply sufficient collective pitch to slow the rate of descent and assist deceleration. Coordinate cyclic to maintain ground track while using antitorque pedals to keep skids aligned in direction of landing. At an altitude of 1 to 3 feet, smoothly apply additional collective pitch to cushion the touchdown while using the cyclic to place the helicopter in a "skids level" attitude prior to touchdown. Minimum ground slide is desired.

(c) After ground contact is made, hold collective pitch stationary. Position cyclic as necessary to level the rotor system, maintaining direction and heading with pedals.

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.

11. 180° AUTOROTATION

a. Required.

(1) Prelanding check - complete.

(2) Heading - downwind (or in the opposite direction of traffic).

(3) Entry altitude - as directed.

(4) Entry airspeed - 60 knots.

(5) During descent - 180° turn.

b. Description of maneuver.

(1) Entry. Reduce collective pitch to the FULL DOWN position maintaining heading by proper application of antitorque pedals, and establishing engine rpm at 2300. Apply cyclic control pressure to start a turn. Adjust degree of bank to insure rollout aligned with touchdown area. Maintain 60 knots and make frequent visual checks for rotor rpm during descent (must be within the allowable limits.)

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

12. 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 during initial takeoff.

a. Required.

(1) Altitude not to exceed 3 feet.

(2) Head helicopter into the wind.

(3) Vertical descent.

b. Analysis of maneuver.

(1) Close throttle to the override 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.

13. 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, 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 the FULL DOWN position while simultaneously applying the right pedal as required to properly trim the aircraft.

(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 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. (Broadcast a MAYDAY message if time permits.)

(6) Check rotor rpm and call out (for example) "rotor in the low green."

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

NOTE: OVERRIDE 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. 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."

NOTE: The command, "TOUCHDOWN," is used only when local regulations permit touchdowns from simulated forced landings.

(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 and recovered prior to passing below 100 feet above highest obstacle in the practice area.

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 and throttle 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 autorotative, but must be given at an altitude that will enable the student to apply operating rpm 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 throttle.

(2) Student immediately lowers the collective pitch to the FULL DOWN position, while simultaneously

applying sufficient antitorque pedal to trim the aircraft, switch on landing light, and continue as in a normal forced-landing procedure.

(3) As soon as the collective pitch is full down, 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 than 200 feet above the ground.

14. TRAFFIC PATTERN

a. Required.

(1) Altitude - as directed.

(2) Airspeed - downwind 60 knots.

b. Analysis of maneuver. After takeoff, climb straight ahead at 50 knots airspeed to required altitude, turn on the crosswind leg, and continue to climb at 50 knots airspeed. (The downwind turn may be made as the crosswind turn is completed, after reaching traffic altitude, or started so that traffic altitude and airspeed 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 to lose altitude steadily, while maintaining airspeed at 60 knots. Plan the turn from the base leg to approach leg to align the helicopter with the selected lane at the assigned altitude.

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. 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.

15. PRECISION AUTOROTATION (Familiarization Only)

a. Required.

(1) Prelanding check - complete.

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

(3) Entry altitude - as directed.

(4) Entry airspeed - 60 knots.

(5) Rotor speed - within allowable limits.

(6) Touchdown - on predetermined spot.

b. Analysis of maneuver. Four 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) The deceleration attitude may be varied to touchdown on a predetermined spot at the desired forward speed.

(4) 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 slight 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.

PART II. BASIC INSTRUMENTS

16. INSTRUMENT TAKEOFF

a. Definition. A takeoff completed solely with reference to all available instruments. A maneuver performed when there is no outside visual reference to control the attitude of the aircraft.

b. Maneuver procedure. After runup and appropriate clearance is received, hover to the active runway or pad and use the following procedure in accomplishing an instrument takeoff:

(1) Align aircraft with center of runway or pad and apply wind drift correction.

(2) Rotate heading index to the heading shown (12 o'clock position).

(3) Set the miniature aircraft of the attitude indicator one bar above the horizon bar. One-bar width above is defined as the miniature aircraft setting on the top of the horizon bar.

(4) Apply sufficient friction to collective pitch control and throttle to minimize overcontrol.

(5) Scan all engine instruments to determine operation in proper range.

(6) Takeoff is started by making a predetermined power adjustment to takeoff power setting. (Hover power plus 5 inches of mercury—not to exceed MAP 270 hp.) Power must be added smoothly and steadily.

(7) Apply collective pitch until aircraft is light on skids. (Student's vision is outside the aircraft at this

time.) Increase collective pitch to the predetermined power setting. Maintain directional control (heading) with pedals.

(8) When a definite climb is established (check altimeter and vertical speed indicator), apply forward cyclic to obtain a sight picture on the attitude indicator of two-bar widths below the horizon bar. After attaining an airspeed of 20 to 30 knots, transition to coordinated flight.

(9) Maintain level flight attitude laterally (wings level) with cyclic.

(10) As the airspeed approaches the desired climbing airspeed of 50 knots, the nose is gradually raised to the appropriate climbing attitude.

(11) As climbing airspeed and attitude is attained, the power should be adjusted to result in a rate of climb of 500 fpm.

NOTE: Do not exceed power restrictions (270 hp for 2 minutes, 220 to 270 hp for 5 minutes).

(12) Trim as required through all steps.

(13) After leveloff, adjust attitude indicator for level flight.

17. STRAIGHT-AND-LEVEL FLIGHT

a. Effects of turbulence on straight-and-level flight usually cause constant changes in the helicopter's attitude, altitude, and heading. In every flight attitude, the forces acting on the helicopter have a definite relationship. These forces (lift, weight, drag, and thrust) must be in balance for straight-and-level, unaccelerated flight. When the instrument indicates a need for an

adjustment to maintain a given performance, other instruments will reflect the amount and direction in which the adjustment should be made. For example, if the airspeed indicator shows a decrease in airspeed, the manifold pressure and/or altimeter will indicate the adjustment to be made in power and/or altitude. When altitude, airspeed, and level flight are being maintained, the miniature airplane of the attitude indicator should be adjusted to reflect the level flight attitude; thereafter, any deviation in attitude can be read directly from the attitude indicator. Corrections for attitude should be made when any deviation is observed.

b. Any deviation from the desired heading will be shown on the heading indicator. Immediate and smooth application of controls should be initiated to return the aircraft to the desired heading. The sooner a need for a correction is observed, the smaller the amount of correction needed. For deviations of 20° or less, a half-standard rate turn should be sufficient. Any time an instrument indicates a change in attitude, necessary adjustment should be made. Then, instead of watching that particular instrument to see the effects of the adjustment, the cross-check is continued before finally returning to the original instrument. In this way, the entire panel will reflect the total effect of the adjustment. A helicopter does not remain long in any given attitude; therefore, by the time a cross-check has been completed and the necessary adjustments have been made, another cross-check must be initiated.

c. During straight-and-level flight, heading and airspeed are maintained with cyclic control, altitude with power, and trim with pedals. Power is used to adjust minor variations of altitude only if the desired altitude cannot be maintained by varying pitch attitude without exceeding ±10 knots airspeed.

18. CLIMBS AND DESCENTS

a. Definition. A climb or descent is a maneuver where the aircraft is intentionally climbed or descended at a specific rate.

b. Maneuver procedure. Establish the aircraft at the desired climbing (50 knots) or descending (60 knots) airspeed and proceed as follows:

(1) Adjust to maintain the desired rate of climb or descent.

(2) As power is adjusted, keep aircraft in trim with pedals.

(3) If the initial power adjustment does not produce the desired rate of climb or descent, then adjustments of power and/or pitch should be made. (Refer to (1) above.)

(4) As a rule of thumb, 1 inch of manifold pressure will change the rate of climb or descent 100 fpm.

(5) A 5-knot change in airspeed, by varying pitch attitude, may be used for minor variations of rate of climb or descent. If a 5-knot change of airspeed fails to give the desired results, then a power adjustment must be made.

(6) Lead the leveloff and adjust the power to maintain the desired airspeed and level flight.

(7) To level off from a descent, power is adjusted prior to reaching the desired altitude; whereas, to level off from a climb, adjust power after aircraft has reached 60 knots in level flight. The amount of lead depends upon the rate of climb or descent and/or individual technique. (A rule of thumb is 40 feet lead.)

19. ACCELERATION AND DECELERATION

a. Definition. Acceleration and deceleration is a maneuver designed to develop coordination of all controls.

b. Maneuver procedure. Establish the aircraft in straight-and-level flight; 60 knots, accelerate to 70 knots, decelerate to 40 knots, and accelerate to 60 knots.

(1) Adjust power to acceleration or deceleration setting. (As a rule, 1 inch of manifold pressure will result in a 5-knot change in airspeed. An additional 2 inches of MAP may be used to expedite the maneuver.) Therefore, to accelerate, power is increased 4 inches above cruise MAP; then, as desired airspeed is approached, power is reduced to maintain 70 knots. To decelerate, power is reduced to 6 inches below cruise MAP; then, as desired airspeed is approached, power is increased to maintain 40 knots.

(2) Adjust pitch attitude for acceleration or deceleration.

20. TIMED TURNS AND NEEDLE CALIBRATION

a. Definition. A timed turn is a turn in which the clock and turn indicator are the instruments used while turning the aircraft a definite number of degrees.

b. Maneuver procedure. In the event of heading indicator failure, turns can be made accurately by the time-turn method; but only if the turn needle is properly calibrated. Calibration should be accomplished as soon as possible after takeoff.

(1) Calibrating the needle.

(a) Establish an indicated standard rate turn in either direction. The initial bank should be established with reference to the attitude indicator. Make minor adjustments with reference to the rate-of-turn indicator to establish a standard rate turn.

(b) Check the second hand of the clock as heading indicator passes any 30° point.

(c) Check elapsed time after 30° of turn (10 seconds ±1 second).

(d) Any deviation is corrected by adjusting rate of turn until a turn of 3° per second is established.

(e) Note the position of the properly calibrated needle and use this in subsequent timed turns.

(f) Roll into a turn in the opposite direction and repeat steps (1) through (5).

(2) Timed turns.

(a) Turns of 20° or more of desired change of direction.

1. Calculate time required for the turn (3° per second).

2. Start turn as the second hand of the clock passes a cardinal point (12, 3, 6, 9) with a coordinated application of controls.

3. Maintain a standard rate turn (3° per second) until the total calculated time has elapsed.

4. Coordinated rollout to straight-and-level flight. (Roll-in and rollout must be at the same rate.)

(b) Turns of less than 20° will be accomplished with procedures shown in b(2)(a) above, except the rate of turn will be one-half standard rate (1 1/2° per second).

21. COMPASS TURNS

a. Definition. Compass turns are turns made to various magnetic headings, using the emergency panel minus the clock. Compass turns error is an amount of lead or lag that must be used when turning to a heading of north and south, varying with the equal to the latitude at this locality.

b. Maneuver procedure. Turns terminating in north or south involve the maximum error equal to the degree of latitude; in this case, 30°. Since the compass turns slower than the aircraft when turning through north from east or west, and faster than the aircraft when turning through south, the effect cancels and no error is present at east or west. Therefore, latitude error is determined by the number of degrees the heading varies from the zero (east or west) reference point. To simplify computation, use the following procedure:

(1) Determine angular difference in degrees between east or west, as appropriate, and the desired heading.

(2) The lead for rollout must be computed in addition to the latitude error; the rule of thumb for computing the rollout lead is: One-half the angle of bank, added or subtracted, to the latitude error.

(3) Since 30° of error is involved in 90° of turn (1° of error for 3° of turn), divide the degrees of angular difference by three to determine latitude error.

(4) In turns terminating in northerly quadrant, roll out early the amount of latitude error plus one-half the angle of bank. For southern quadrant, roll out after turning past the desired heading the amount of latitude error minus one-half the angle of bank.

(5) Upon arrival at desired compass indication, roll out straight and level.

22. CLIMBING AND DESCENDING TURNS

a. Definition. Climbing and descending turns involve 180° change in heading, a 500-foot change of altitude. The maneuver combines a standard rate turn (3° per second) and a standard-rate climb or descent (500 fpm). Climb is executed at 50 knots airspeed. Descent is executed at 60 knots airspeed. Properly executed, the maneuver will be accomplished in 1 minute. In this maneuver, the rate of climb or descent and the rate of turn are both checked against time. A very rapid cross-check throughout this maneuver is required for precise execution.

b. Maneuver procedure. With the aircraft established at cruise and on a given cardinal heading, the maneuver is performed as follows:

(1) When the second hand passes a cardinal point, a standard rate turn and a standard rate climb or descent are simultaneously entered. As power is adjusted to a predetermined setting, torque corrections should be made with pedals to maintain trimmed flight conditions.

(2) The initial bank should be established with reference to the attitude indicator and the rate-of-turn indicator. To maintain the rate of turn, minor corrections should be made with reference to the rate-of-turn indicator. Proper pitch attitude is maintained by reference to the attitude indicator and the airspeed indicator.

(3) During the climb or descent, the rate of turn, rate of climb, and airspeed are maintained with cyclic control. Trim is maintained with pedals, rate of climb or descent with power, and pitch attitude supported by airspeed. Power is used to adjust rate of climb or descent only if the desired airspeed must be changed by more than ±5 knots to maintain a 500-fpm climb or descent.

(4) In cross-checking altitude and heading against time, a 15-second cross-check is used. After 15 seconds, the aircraft will have turned 45° and climbed 125 feet; after 30 seconds, 90° of turn and 250 feet of altitude; after 45 seconds, 135° of turn and 375 feet of altitude. In other words, 45° of turn in relation to 125 feet of altitude for each 15 seconds. It should be noted, however, that the heading and altitude will be slightly behind the time throughout the maneuver because of the time involved during the entry process. Time starts when control pressures are initiated to start the maneuver and stops when control pressures are applied to terminate the maneuver. Disregarding time, recovery should be initiated to place the aircraft on the desired heading and altitude.

23. STEEP TURNS

a. Definition. A steep turn is any turn greater than standard rate. A 3 to 3 1/3-needle width rate of turn is the accepted steep turn.

CAUTION: 30° angle of bank is a not to be exceeded figure when performing steep turns in the TH-13T.

b. Maneuver procedure. The technique of entry and control during the turn and recovery are the same as used in a standard rate turn.

(1) Entry to the maneuver is made with a coordinated roll into an angle of bank required to maintain a

steep turn. Angle of bank should be constant after the bank has been established.

(2) During the turn, a rapid cross-check is required to maintain a constant bank and airspeed. Power may be required to prevent loss of airspeed in the turn.

(3) Recovery from the maneuver should be made with a smooth rollout. A rapid cross-check must be used during the "after recovery" from this maneuver. Recovery technique is the same as recovery from a standard rate turn.

24. RECOVERY FROM UNUSUAL ATTITUDE

a. Definition. Any attitude not required for normal instrument flight which may be caused by turbulence, vertigo, instrument failure, or carelessness.

b. Maneuver procedure. Upon detection of an unusual attitude, a recovery to straight-and-level flight should be made immediately, with minimum loss of altitude, minimum change of heading, and navigation resumed.

(1) To recover from an unusual attitude, correct the bank-and-pitch attitudes and adjust power. For all practical purposes, these are corrected simultaneously.

(2) Care must be taken to prevent overcontrolling.

(3) Avoid zero airspeed maneuvers.

25. HYDRAULIC BOOST FAILURE

a. Definition. Hydraulic boost failure is loss of the control boost system and will be evident by feedback forces being transmitted to the controls.

b. Maneuver procedure. Hydraulic boost failure is simulated by turning off the hydraulic system switch. The procedure to follow is—

(1) Maintain desired heading and altitude.

(2) Airspeed should be adjusted to obtain minimum control feedback (50 to 60 knots).

(3) Check hydraulic control circuit breaker - OUT; if power is not restored - IN.

(4) Hydraulic control switch - RECYCLE; if power is not restored - OFF.

(5) Contact control agency - report failure, request clearance.

(6) Landing - accomplish at nearest available safe landing area, using a normal approach to the ground.

26. AUTOROTATIONS (Forced Landings)

a. Definition. The term used to describe a descent without power in a helicopter.

b. Maneuver procedure. In event of power failure or other emergencies requiring autorotation, prompt corrective action must be taken to insure positive control of the aircraft. Instructor pilots will initiate forced landings by slowly reducing engine rpm to 2300 and stating "forced landing."

(1) Student will reduce collective pitch smoothly to maintain safe rotor rpm; pedals must be trimmed to assure coordinated flight. The attitude of the aircraft should be wings level and the airspeed adjusted to the autorotative speed (60 knots). (Broadcast a MAYDAY message if time permits.)

(2) Maintain heading. Check rotor rpm in the green, and repeat this to the instructor.

(3) Practice autorotations will be terminated with a power recovery. Recovery is begun so as to stop the descent at a desired altitude. A lead of 200 feet is recommended to prevent overcontrolling the aircraft.

(4) Recovery is accomplished by adjusting collective pitch to bring the rotor rpm within the engine rpm limits; then, power is applied to join the needles, and manifold pressure is increased to desired power setting. Pedals must be trimmed to maintain coordinated flight during power application. Maintain altitude, airspeed, and heading until given further instruction.