PRIVATE PILOT

IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS

B. TASK: CONSTANT AIRSPEED CLIMBS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during constant airspeed climbs.
2. Establishes the climb configuration specified by the examiner.
3. Transitions to the climb pitch attitude and power setting on an assigned heading using proper instrument cross-check and interpretation, and coordination control application.
4. Demonstrates climbs solely by reference to instruments at a constant airspeed to specific altitudes in straight flight and turns.
5. Levels off at the assigned altitude and maintains that altitude +/-200 feet (60 meters), heading +/-20°, and airspeed +/-10 knots.

ELEMENTS

1. With the integrated method of flight instruction, both outside references and flight instruments are used to maintain desired airplane performance.
2. The constant airspeed climb is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. When an airplane enters a climb, it changes its flightpath from level flight to an inclined plane.
4. In a climb attitude, weight no longer acts in a direction near-perpendicular to the flightpath - it now has a rearward component increasing total drag and requiring more thrust.
5. Absolute ceiling: Altitude at which level flight can be maintained.
6. Service ceiling: Altitude at which a 100 feet-per-minute climb can be maintained.
7. Military ceiling: Altitude at which a 500 feet-per-minute climb can be maintained.
8. The best rate of climb airspeed (V_Y):
    a. Depends on excess power available over that required for level flight.
    b. Decreases with altitude and equals V_X at the absolute ceiling.
9. The best angle of climb airspeed (V_X):
    a. Depends on excess thrust available over that required for level flight.
    b. Increases with altitude and equals V_Y at the absolute ceiling.
10. A faster “cruise climb” provides better engine cooling, increased forward visibility and higher groundspeed than V_X or V_Y.
11. A straight climb is entered by gently applying back-elevator pressure to raise the nose of the airplane relative to the horizon and simultaneously increasing engine power to a climb power setting.
12. Slower airspeed and increased angle of attack produce the left turning tendencies from torque and asymmetrical propeller loading (P-factor) - offset these by applying more right rudder.
13. If establishing a climbing turn:
    a. The pitch angle and climb rate must be less since the bank angle creates a horizontal component of lift by reducing the vertical component of lift.
    b. The degree of bank should be shallow and constant. When the bank angle is too large, a climb is no longer possible.
    c. Maintain a coordinated turn at constant airspeed and rate of turn.
    d. Because of the lower airspeed, aileron drag (adverse yaw) will be more prominent than in straight-and-level flight - more correcting rudder pressure will be needed.
14. After the climb is established at the climbing airspeed, trim out control pressures.
15. For climbs solely by reference to instruments:
    a. The AI is the control instrument (the center of the scan)
        i. The AI gives a direct indication of pitch and bank attitude.
        ii. The pilot’s instrument scan radiates out from the AI.
    b. Raise the miniature aircraft to the appropriate nose high indication and simultaneously increase the engine power to a climb power setting (other methods include maintaining cruise power until the desired climb airspeed is attained, or decreasing power in straight-and-level flight to attain climb airspeed before beginning the climb).
        i. Allow the airspeed to stabilize for the selected attitude and power setting.
        ii. If the airspeed is low or high, make a small pitch correction nose-down or nose-up.

c. The altimeter, vertical speed indicator (VSI) and airspeed indicator (ASI) are the performance instruments for pitch:
    i. The altimeter gives an indirect indication of pitch attitude (assuming constant power).
    ii. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from the desired climb rate, the larger the correction. As the needle returns to the desired climb rate, relax the correction pressure.
    iii. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from the desired climb airspeed, the larger the correction. As the needle returns to the desired climb airspeed, relax the correction pressure
    iv. The pilot's instrument scan for pitch should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).
d. The heading indicator (HI) and the turn coordinator (TC) are the performance instruments for bank:
    i. The HI gives an indirect indication of bank attitude. To correct, use a bank angle no larger than the number of degrees to be turned.
    ii. The TC gives an indirect indication of bank attitude. With either a ball or miniature airplane deflection, the airplane is in a turn.
    iii. The pilot's instrument scan for bank should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

16. To return to straight-and-level flight, lead the level-off by 10% of the climb rate (50' for 500 FPM).
17. Lower the nose gradually to allow airspeed to increase and prevent altitude loss.
18. Retain climb power temporarily to accelerate to cruise airspeed.
19. Reduce engine power to a cruise power setting.
20. After allowing time for engine temperature to stabilize, adjust the mixture control.
21. After straight-and-level flight is established at the desired airspeed, trim out control pressures.
22. For climbs by outside references, the pilot's attention should be outside the cockpit 90% of the time - no more than 10% of the pilot's attention should be inside the cockpit (instrument cross-checks).

COMMON ERRORS

a. "Fixation," "omission," and "emphasis" errors during instrument cross-check.
b. Improper control applications.
c. Attempting to establish climb pitch attitude by referencing the airspeed indicator, resulting in "chasing" the airspeed.
d. Improper entry or level-off procedure.
e. Applying elevator pressure too aggressively, resulting in an excess climb angle.
f. Applying elevator pressure too aggressively during level-off resulting in negative "G" forces.
g. Inadequate or inappropriate rudder pressure during climbing turns.
h. Allowing the airplane to yaw during straight climbs, usually due to inadequate right rudder pressure.
i. Fixation on the nose during straight climbs, resulting in climbing with one wing low.
j. Failure to initiate a climbing turn properly with use of rudder and elevators, resulting in a slip or skid and little or no altitude gain.
k. Inability to keep pitch and bank attitude constant during climbing turns.
l. Attempting to exceed the airplane's climb capability.
m. Improper instrument interpretation.
n. Failure to establish proper pitch, bank or power adjustments during altitude, heading, or airspeed corrections.
o. Faulty trim procedure.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.