

## **PRIVATE PILOT**

### **IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS**

#### **D. TASK: TURNS TO HEADINGS**

#### **OBJECTIVE**

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during turns to headings.
2. Transitions to the level-turn attitude using proper instrument cross-check and interpretation, and coordination control application.
3. Demonstrates turns to headings solely by reference to instruments, maintains altitude +/-200 feet (60 meters), maintains a standard rate turn and rolls out on the assigned heading +/-10°, and maintains 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 turn to heading is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. A turn is made by banking the wings to a desired angle in the direction of the turn and exerting the control pressures needed to maintain that bank.
4. All four primary controls are used in close coordination:
  - a. Ailerons bank the wings and determine the rate of turn at a given airspeed.
  - b. The elevator moves the nose of the airplane up or down perpendicular with the wings (sets the pitch attitude in the turn and “pulls” the nose around the turn).
  - c. The throttle provides thrust which may be used for airspeed or to tighten the turn.
  - d. The rudder offsets adverse yaw developed by other controls (does not turn the airplane).
5. There are three classes of turns: Shallow, medium and steep:
  - a. Shallow turns: Bank < 20°, inherent lateral stability acting to level the wings.
  - b. Medium turns: Bank = 20° to 45°, neutral lateral stability maintains bank.
  - c. Steep turns: Bank > 45°, overbanking tendency acting to increase the bank.
6. As the airplane is banked into a turn, the lift becomes the resultant of two components:
  - a. The vertical lift component continues to act perpendicular to the Earth’s surface and oppose gravity but is reduced if pitch or power is not increased.
  - b. The horizontal lift component (centripetal) acts parallel to the Earth’s surface and turns the airplane by opposing inertia.
7. Part of the vertical lift has been diverted to horizontal lift – the total lift must be increased to compensate for this loss:
  - a. To maintain altitude, pitch must be increased by applying back elevator pressure.
  - b. To maintain airspeed, power must be increased.
8. To counteract the adverse yawing moment caused by the lowered aileron (on the raised wing) producing more drag than the raised aileron (on the lowered wing), rudder is applied in the direction of the turn.
9. In a skid, the rate of turn is too fast for the angle of bank:
  - a. The tail of the airplane tends to move up and to the outside of the turn.
  - b. The pilot feels a sideways force to the outside of the turn.
  - c. The ball in the turn coordinator is “thrown” to the outside of the turn.
10. In a slip, the rate of turn is too slow for the angle of bank:
  - a. The tail of the airplane tends to move down and to the inside of the turn.
  - b. The pilot feels a sideways force to the inside of the turn.
  - c. The ball in the turn coordinator “falls” to the inside of the turn.
11. In a coordinated turn, the rate of turn is correct for the angle of bank:
  - a. The tail of the airplane remains in the slipstream directly behind the airplane.
  - b. The pilot feels a force straight down into the seat.
  - c. The ball in the turn coordinator is centered.
12. The best outside reference for establishing the degree of bank is the angle made by the top of the engine cowling and the horizon.
13. The pilot’s posture while seated in the airplane affects the interpretation of visual references – the head should remain upright relative to the engine cowling, not tilted upright relative to the horizon.

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14. When seated in the left seat, parallax makes the nose appear to rise in a left turn (beginning pilots tend to descend) and descend in a right turn (beginning pilots tend to climb).
15. If the nose starts to turn before the bank starts, rudder is being applied too soon.
16. If the bank starts before the nose turns, the rudder is being applied too late.
17. If the nose moves up or down, insufficient back elevator is being applied.
18. Throughout the turn, the pilot should cross-check the ASI. If the airspeed is off by more than 5 knots, an adjustment in power should be applied.
19. Throughout the turn, the pilot should cross-check the altimeter and VSI. If the altitude or vertical speed desired is not being maintained, an adjustment in pitch should be applied.
20. For turns 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. Bank and slightly raise the miniature aircraft to the appropriate indication and simultaneously increase the engine power slightly.
  - c. The altimeter, VSI and ASI are the performance instruments for pitch:
    - i. The altimeter gives an indirect indication of pitch attitude.
    - ii. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from zero, the larger the correction. As the needle returns to zero, relax the correction pressure.
    - iii. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from that desired, the larger the required correction.
    - 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 HI and the TC are the performance instruments for bank:
    - i. The HI gives an indirect indication of bank attitude and rate of turn.
    - ii. The TC gives an indirect indication of bank attitude.
    - 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).
21. For the rollout from a turn, the flight controls are applied in the opposite direction.
22. Normally the lead for rollout is one-half the bank (lead heading by 15° for a 30° bank).
23. For turns 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. Failure to adequately clear the area before beginning the turn.
- b. Attempting to execute the turn solely by instrument reference.
- c. "Fixation," "omission," and "emphasis" errors during instrument cross-check.
- d. Improper instrument interpretation.
- e. Attempting to sit up straight relative to the ground in turns, rather than riding with the airplane.
- f. "Ground shyness" – making "flat turns" (skidding) while operating at low altitudes in a conscious or subconscious effort to avoid banking close to the ground.
- g. Holding rudder in the turn, resulting in skidding.
- h. Insufficient feel (inability to detect slips or skids without reference to flight instruments).
- i. Gaining proficiency in turns in only one direction (usually to the left).
- j. Failure to coordinate the use of throttle with other controls.
- k. Failure to establish proper pitch, bank, and power adjustments during altitude, bank, and airspeed corrections.
- l. Altitude gain or loss during the turn.
- m. Improper entry or rollout procedure.
- n. Faulty trim procedure (if adjustments to trim are used).

#### **REFERENCES**

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