

V. AREA OF OPERATION: PERFORMANCE MANEUVER

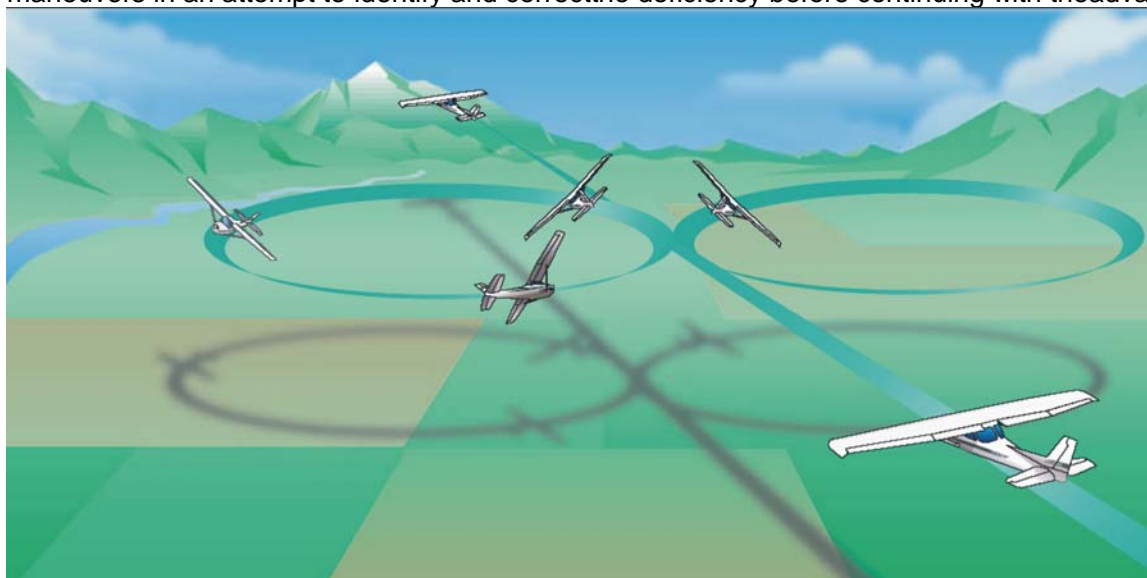
TASK: STEEP TURNS

1. Exhibits knowledge of the elements related to steep turns.
2. Establishes the manufacturer's recommended airspeed or if one is not stated, a safe airspeed not to exceed V_A .
3. Rolls into a coordinated 360° turn; maintains a 45° bank.
4. Performs the task in the opposite direction, as specified by the examiner.
5. Divides attention between airplane control and orientation.
6. Maintains the entry altitude, ± 100 feet (30 meters), airspeed, ± 10 knots, bank, $\pm 5^\circ$; and rolls out on the entry heading, $\pm 10^\circ$.

PERFORMANCE MANEUVERS

Performance maneuvers are used to develop a high degree of pilot skill. They aid the pilot in analyzing the forces acting on the airplane and in developing a fine control touch, coordination, timing, and division of attention for precise maneuvering of the airplane. Performance maneuvers are termed "advanced" maneuvers because the degree of skill required for proper execution is normally not acquired until a pilot has obtained a sense of orientation and control feel in "normal" maneuvers. An important benefit of performance maneuvers is the sharpening of fundamental skills to the degree that the pilot can cope with unusual or unforeseen circumstances occasionally encountered in normal flight. Advanced maneuvers are variations and/or combinations of the basic maneuvers previously learned. They embody the same principles and techniques as the basic maneuvers, but require a higher degree of skill for proper execution. The student, therefore, who demonstrates a lack of progress in the performance of advanced maneuvers, is more than likely deficient in one or more of the basic maneuvers.

The flight instructor should consider breaking the advanced maneuver down into its component basic maneuvers in an attempt to identify and correct the deficiency before continuing with the advanced



maneuver.

STEEP TURNS

The objective of the maneuver is to develop the smoothness, coordination, orientation, division of attention, and control techniques necessary for the execution of maximum performance turns when the airplane is near its performance limits. Smoothness of control use, coordination, and accuracy of execution are the important features of this maneuver. The steep turn maneuver consists of a turn in either direction, using a bank angle between 45 to 60°. This will cause an overbanking tendency during which maximum turning performance is attained and relatively high load factors are imposed. Because of the high load factors imposed, these turns should be performed at an airspeed that does not exceed the airplane's design maneuvering speed (V_A). The

principles of an ordinary steep turn apply, but as a practice maneuver the steep turns should be continued until 360° or 720° of turn have been completed. An airplane's maximum turning performance is its fastest rate of turn and its shortest radius of turn, which change with both airspeed and angle of bank. Each airplane's turning performance is limited by the amount of power its engine is developing, its limit load factor (structural strength), and its aerodynamic characteristics. The limiting load factor determines the maximum bank, which can be maintained without stalling or exceeding the airplane's structural limitations. In most small planes, the maximum bank has been found to be approximately 50° to 60°. The pilot should realize the tremendous additional load that is imposed on an airplane as the bank is increased beyond 45°. During a coordinated turn with a 70° bank, a load factor of approximately 3 Gs is placed on the airplane's structure. Most general aviation type airplanes are stressed for approximately 3.8 Gs. Regardless of the airspeed or the type of airplane involved, a given angle of bank in a turn, during which altitude is maintained, will always produce the same load factor. Pilots must be aware that an additional load factor increases the stalling speed at a significant rate—stalling speed increases with the square root of the load factor. For example, a light plane that stalls at 60 knots in level flight will stall at nearly 85 knots in a 60° bank. The pilot's understanding and observance of this fact is an indispensable safety precaution for the performance of all maneuvers requiring turns. Before starting the steep turn, the pilot should ensure that the area is clear of other air traffic since the rate of turn will be quite rapid. After establishing the manufacturer's recommended entry speed or the design maneuvering speed, the airplane should be smoothly rolled into a selected bank angle between 45 to 60°. As the turn is being established, back-elevator pressure should be smoothly increased to increase the angle of attack. This provides the additional wing lift required to compensate for the increasing load factor. After the selected bank angle has been reached, the pilot will find that considerable force is required on the elevator control to hold the airplane in level flight—to maintain altitude. Because of this increase in the force applied to the elevators, the load factor increases rapidly as the bank is increased. Additional back-elevator pressure increases the angle of attack, which results in an increase in drag.

Consequently, power must be added to maintain the entry altitude and airspeed. Eventually, as the bank approaches the airplane's maximum angle, the maximum performance or structural limit is being reached. If this limit is exceeded, the airplane will be subjected to excessive structural loads, and will lose altitude, or stall. The limit load factor must not be exceeded, to prevent structural damage. During the turn, the pilot should not stare at any one object. To maintain altitude, as well as orientation, requires an awareness of the relative position of the nose, the horizon, the wings, and the amount of bank. The pilot who references the aircraft's turn by watching only the nose will have difficulty holding altitude constant; on the other hand, the pilot who watches the nose, the horizon, and the wings can usually hold altitude within a few feet. If the altitude begins to increase, or decrease, relaxing or increasing the back-elevator pressure will be required as appropriate. This may also require a power adjustment to maintain the selected airspeed. A small increase or decrease of 1 to 3° of bank angle may be used to control small altitude deviations. All bank angle changes should be done with coordinated use of aileron and rudder. The rollout from the turn should be timed so that the wings reach level flight when the airplane is exactly on the heading from which the maneuver was started. While the recovery is being made, back-elevator pressure is gradually released and power reduced, as necessary, to maintain the altitude and airspeed.

Common errors in the performance of steep turns are:

- Failure to adequately clear the area.
- Excessive pitch change during entry or recovery.
- Attempts to start recovery prematurely.
- Failure to stop the turn on a precise heading.
- Excessive rudder during recovery, resulting in skidding.
- Inadequate power management.
- Inadequate airspeed control.
- Poor coordination.
- Gaining altitude in right turns and/or losing altitude in left turns.
- Failure to maintain constant bank angle.
- Disorientation.
- Attempting to perform the maneuver by instrument reference rather than visual reference.
- Failure to scan for other traffic during the maneuver.

Definition: A turn in either direction, using a bank angle between 45 to 60 degrees

Objective: develop smoothness, coordination, orientation, division of attention, and control techniques while executing high performance turns.

There will be an overbanking tendency

Should be performed at maneuvering speed (100)

Entry

- 1) Roll aircraft into a selected bank angle of 45 degrees
- 2) As the turn begins, increase back pressure
- 3) Add 100 rpm power to maintain airspeed due to the increase in drag

Maintain

- 1) Maintain altitude by increasing or decreasing back pressure
- 2) Maintain a constant bank angle.

Recovery

- 1) Lead the roll out by 25° so you don't overshoot your desired heading
- 2) Release back pressure as you roll out to decrease the added lift and maintain altitude
- 3) Reduce power to maintain airspeed.



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