



Commercial Pilot Ground School

Day 14
Performance Maneuvers

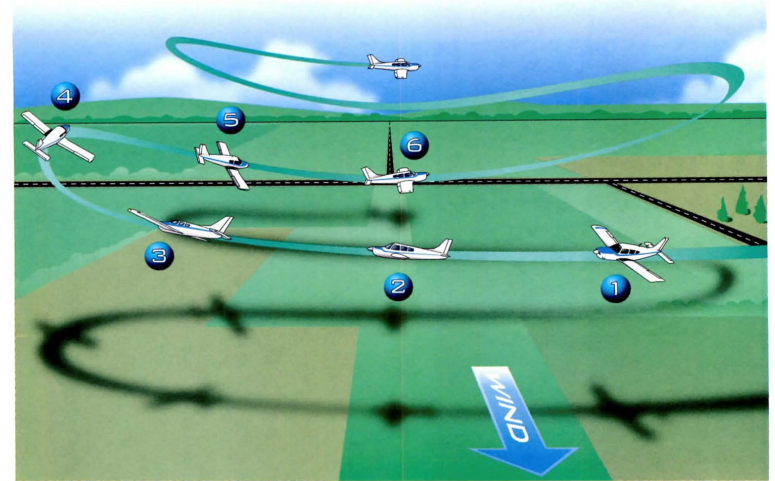


Agenda

- Lazy Eights
- Eights on Pylons
- Steep Turns
- Chandelles
- Steep Spiral

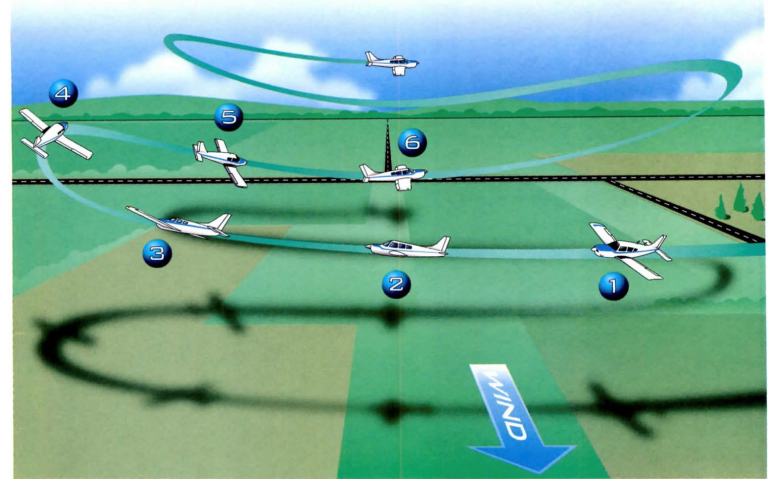
Lazy Eights

- The lazy eight is basically two 180 degrees turns in opposite directions, with each turn including a climb and a descent. It is called a lazy eight because the longitudinal axis of the aircraft appears to scribe a flight pattern about the horizon that resembles a figure eight lying on its side.



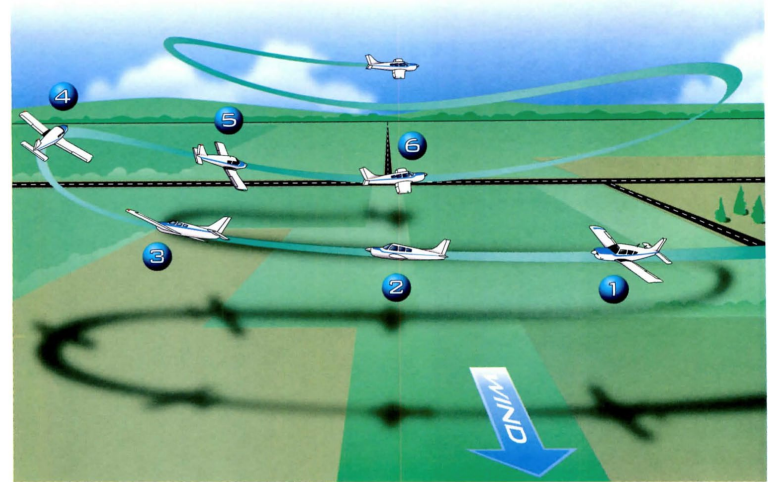
Lazy Eights

- Throughout the maneuver, airspeed, altitude, bank angle, and pitch attitude, as well as control pressures, are constantly changing. Because of these constant changes, you cannot fly the lazy eight mechanically or automatically. The lazy eight requires a high degree of piloting skill and a sound understanding of the associated performance factors. The objective of this maneuver is to develop and improve your coordination, orientation, planning, division of attention, and ability to maintain precise aircraft control. A good way to visualize the lazy eight is to break each 180 degrees turn into segments .



Lazy Eights

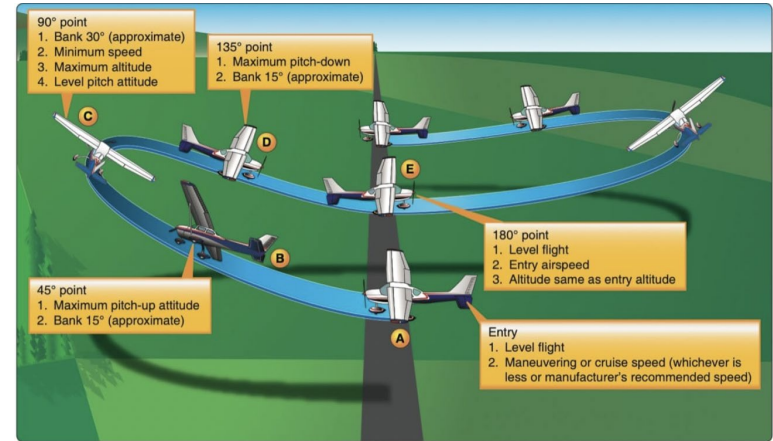
Since you will be changing heading and altitude continually, be particularly careful to maintain vigilance throughout the maneuver. While scanning the area, look for visual reference points that you can use for orientation. You should also try to determine the direction of the wind and an entry reference point on the horizon, which will allow you to make your turns into the wind. Additional reference points at 45 degrees, 90 degrees, and 135 degrees are also useful.



Lazy Eights - Procedure

1) Align your flight path with your initial reference point and establish straight-and- level flight at the recommended airspeed.

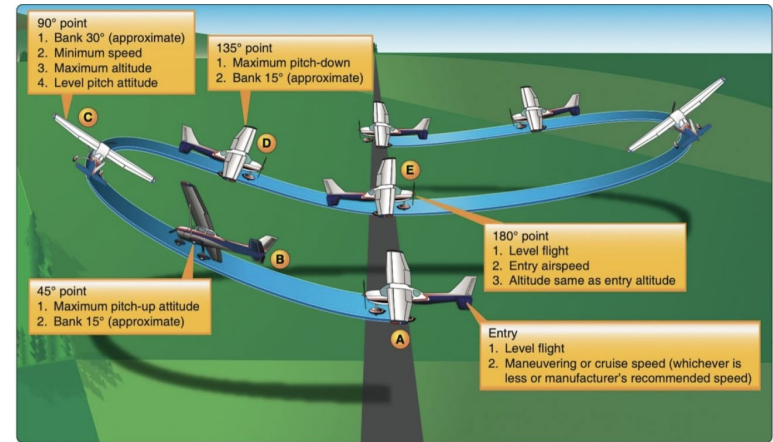
2) Begin a gradual climbing turn toward the 45° point, increasing pitch attitude while you slowly increase the angle of bank.



Lazy Eights - Procedure

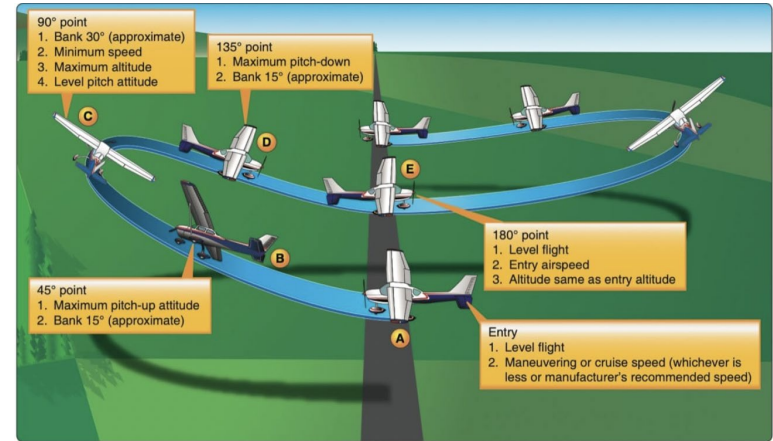
3) As you pass through the 45° point of the turn, your pitch attitude should be at its maximum and your bank angle should be about 15°. From 45° to the 90° point you should begin to decrease your pitch attitude to the horizon and continue to increase the angle of bank.

4) At 90°, you should be in a level flight attitude, at the maximum angle of bank (approximately 30°), and your airspeed should be about 5 to 10 knots above the stall speed. Then, slowly begin to roll out of the 30° bank and gradually lower the nose for the descending turn as you allow the airspeed to increase.



Lazy Eights - Procedure

5) At this point you should immediately begin a climbing turn in the opposite direction toward the selected reference point to complete the second half of the eight in the same manner as the first half.

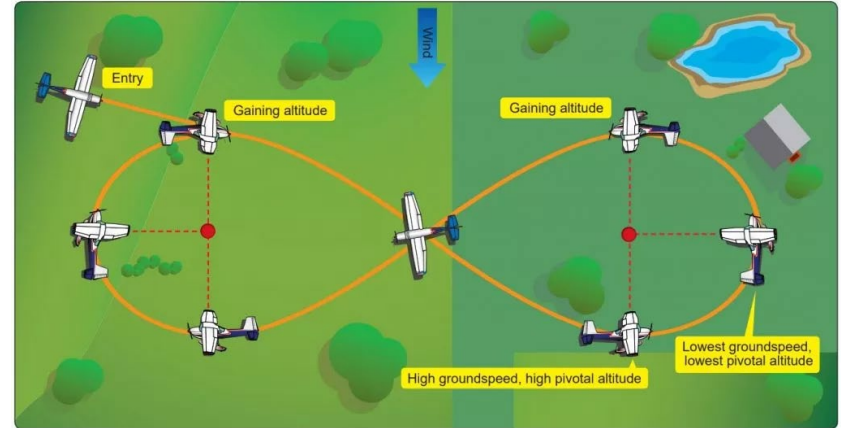


Lazy Eights - Procedure



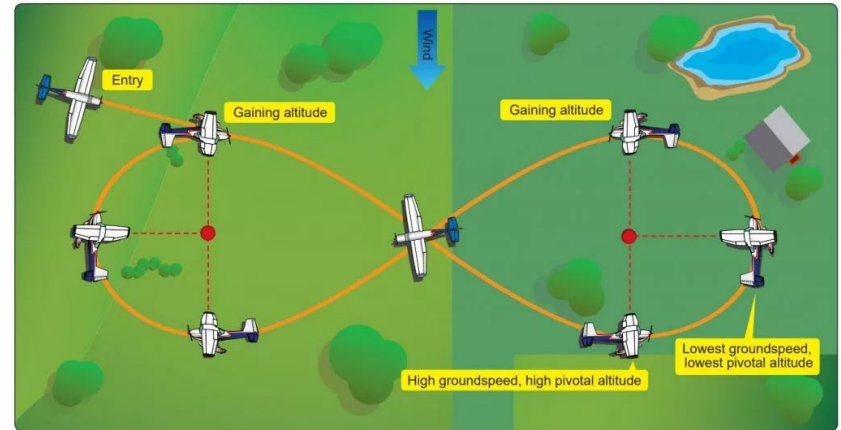
Eights on Pylons

Eights-on-pylons involve flying a figure eight around two points, or pylons, on the ground. In this maneuver, you fly the airplane at an altitude and airspeed that allows you to hold a line-of-sight reference point on the pylon. This reference point should appear to pivot about the pylon. A complete maneuver consists of a turn in one direction around the first pylon, followed by a turn in the opposite direction around the second pylon.



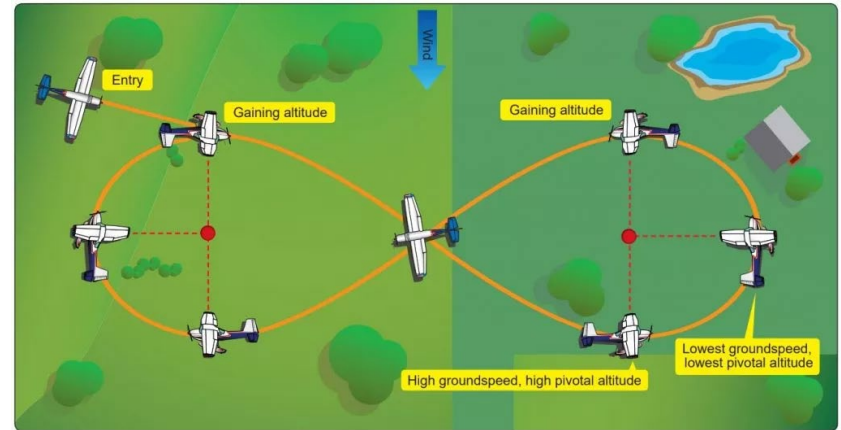
Eights on Pylons

Since you perform this maneuver at a relatively low altitude, select pylons that are in an open area and are not near hills or obstructions. Obstruction-induced turbulence, as well as updrafts and downdrafts caused by uneven terrain, increase the difficulty of the maneuver. Select pylons with approximately the same elevation to avoid the added burden of adjusting altitude for variations in terrain.



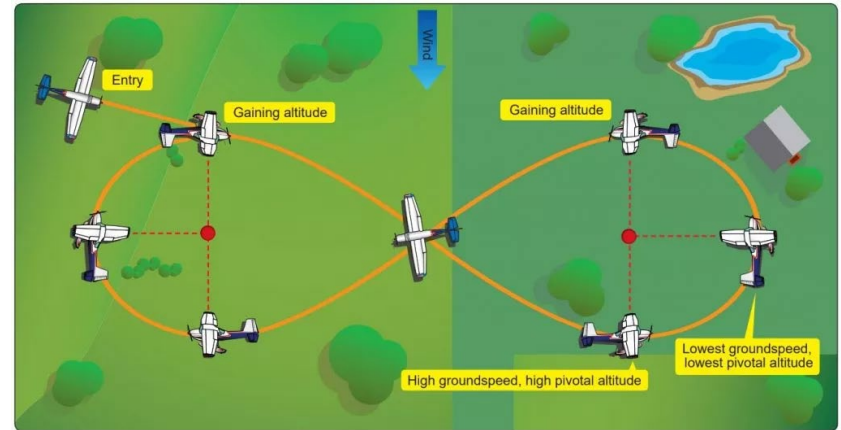
Eights on Pylons

The pylons also should be in a line which is perpendicular to the wind, and they should be spaced to provide three to five seconds of straight-and-level flight between the turns. Carefully select pylons that will be visible, clear of obstructions, and properly oriented in relation to the prevailing wind. The pylons you select should be in a location which will allow for a safe emergency landing.



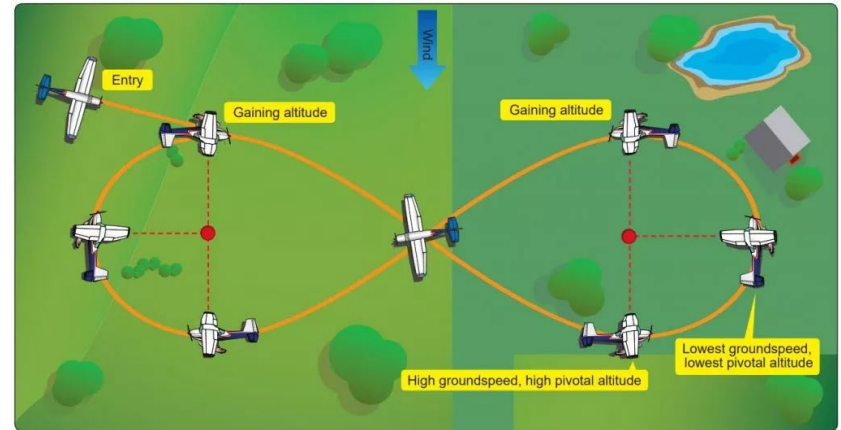
Eights on Pylons - Procedure

- Adjust your power to recommended entry airspeed. As you approach the pylons, the entry altitude you select should be close to the estimated pivotal altitude.
- Begin by flying diagonally crosswind between the pylons to a point downwind from the first pylon so that the first turn can be made into the wind.
- Maintain straight-and-level flight until you are approximately abeam the first pylon, then roll into a 30° to 40° angle of bank.



Eights on Pylons - Procedure

- Gradually decrease your pivotal altitude and slightly reduce your angle of bank as you turn directly into the wind.
- Begin the rollout to straight-and-level flight as you complete the first turn. Maintain straight-and-level flight for 3 to 5 seconds and crab into the wind, as
- Initiate a turn in the opposite direction when the pylon is aligned with the wing reference point.



Eights on Pylons - Video



Steep Turns

Steep turns are level, high-performance turning maneuvers normally performed as a series of 360° turns in opposite directions with a bank angle of approximately 50°, $\pm 5^\circ$. The objective of the maneuver is to help develop the ability to accurately control an aircraft near its maximum performance limits. It also increases your knowledge of the associated performance factors, including load factor, angle-of-bank limitations, effect on stall speed, power required, and the overbanking tendency.



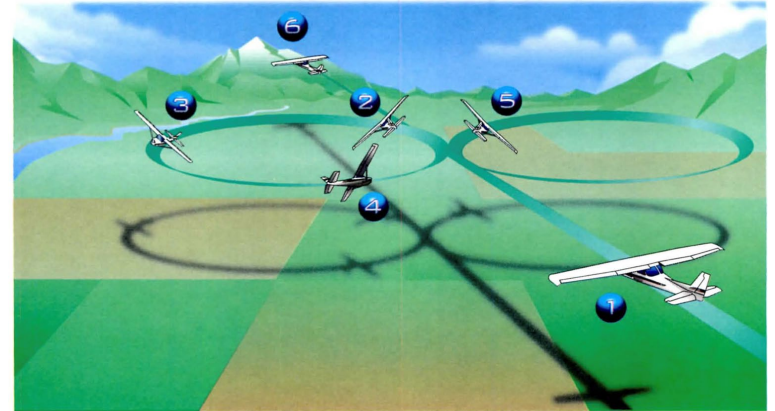
Steep Turns

The actual turning performance of an airplane is limited by the amount of power the engine is developing, load limit (structural strength), and aerodynamic design. As you increase the bank angle, you eventually approach maximum performance or the load limit. In most light airplanes, the maximum bank angle you can maintain with full power is 50° to 60° . If you exceed the maximum performance limit while maintaining your air-speed at or below the airplane's design maneuvering speed (V_A), the airplane will either stall or will lose altitude. With airspeed above V_A , it is possible to exceed the load limit.



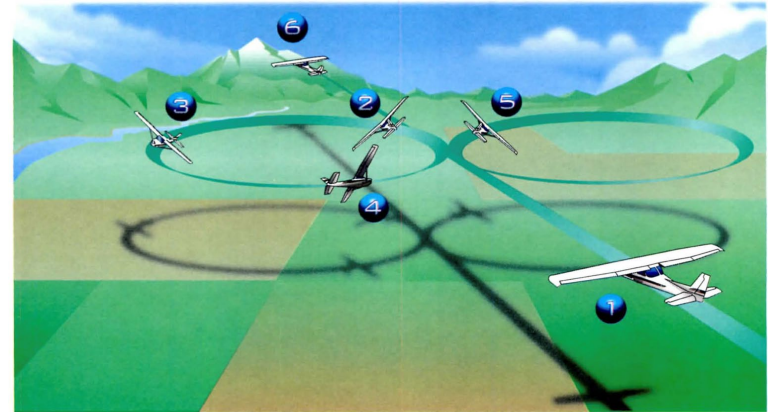
Steep Turns - Procedure

- Upon completion of your clearing turns, select a reference point on the horizon and note your heading and altitude.
- Roll into a 50° angle-of-bank turn at or below VA'. During roll-in, smoothly add power and slowly increase back pressure on the yoke to maintain altitude. Maintain coordinated flight and trim to relieve control pressures.



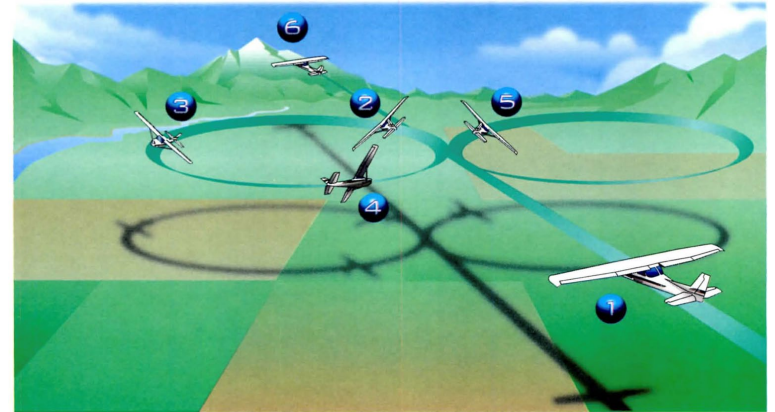
Steep Turns - Procedure

- Maintain your angle of bank and altitude. Confirm your attitude by referring to both the natural horizon and attitude indicator. Use your altimeter and vertical speed indicator to determine if changes in pitch are required.
- Anticipate the change in direction of the turn by leading the roll-out heading by one-half the bank angle, approximately 25° . Roll out on the entry heading and briskly roll into a 50° banked turn in the opposite direction.



Steep Turns - Procedure

- After the initial roll-in to the turn, confirm your attitude by referring to both the natural horizon and attitude indicator. Use your altimeter and vertical speed indicator to determine if changes in pitch are necessary. Anticipate the roll-out by leading the rollout heading approximately 25° .
- Roll out on the entry heading and altitude. Decrease back pressure on the yoke, and reduce power to maintain altitude and airspeed. Trim to relieve control pressures.

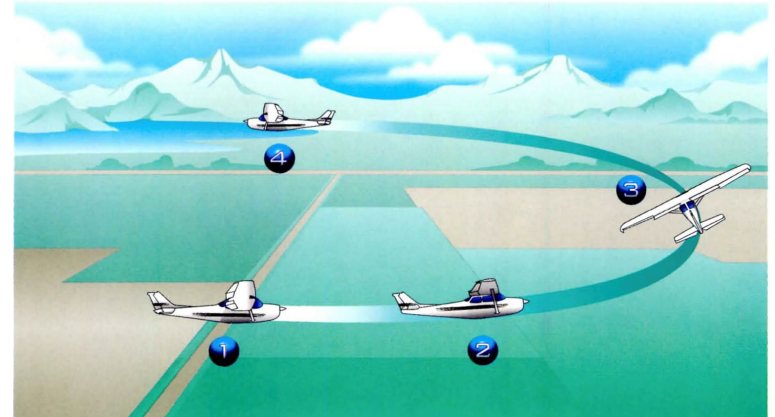


Steep Turns - Video



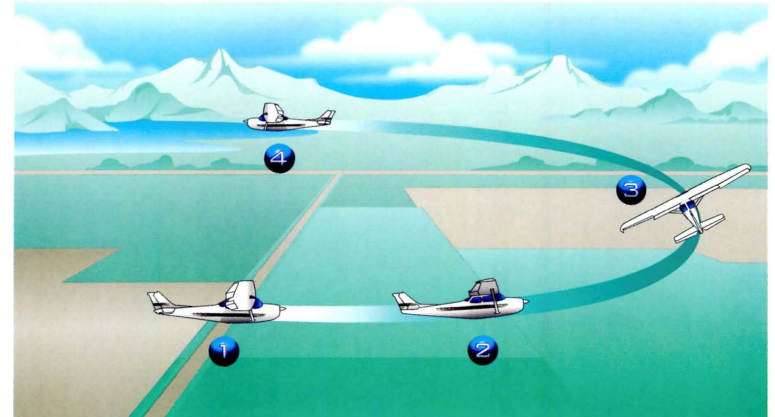
Chandelles

- A chandelle can be described as a maximum performance 180 degree climbing turn. It involves continual changes in pitch, bank, airspeed, and control pressures. During the maneuver, the airspeed gradually decreases from the entry speed to a few knots above stall speed at the completion of the 180 degree turn.
- Since you use full power throughout the chandelle, you must control airspeed by adjusting the pitch attitude of the aircraft.



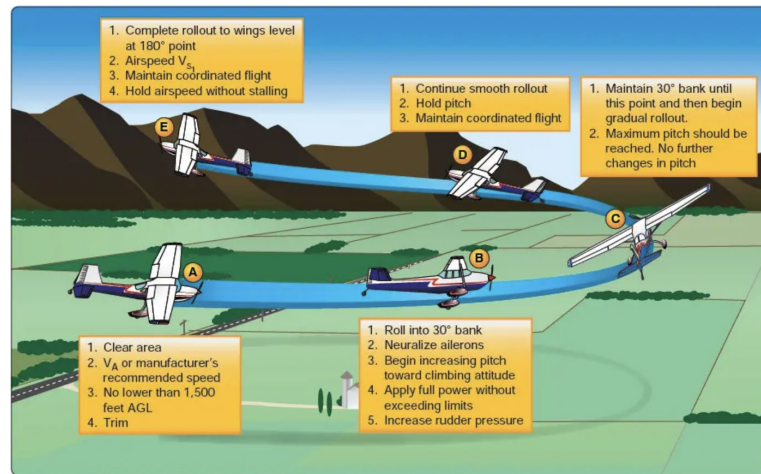
Chandelles

- Because of this, maintaining the proper pitch attitude is a key element of this maneuver. Due to variables, such as atmospheric density and airplane performance, altitude gain is not a criterion for successful completion of a chandelle.
- However, the aircraft should gain as much altitude as possible for the given bank angle and power setting without stalling.
- The objective of the maneuver is to help you develop good coordination habits and refine the use of aircraft controls at varying airspeeds and flight attitudes.



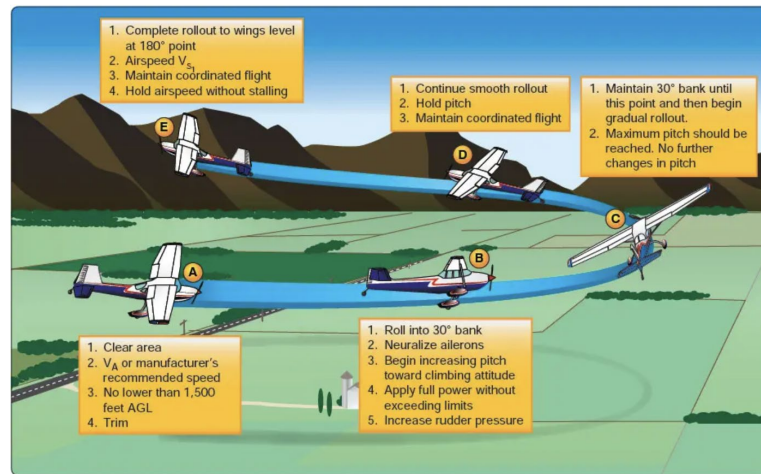
Chandelles - Procedure

- Before entering the maneuver, configure the airplane in straight-and-level flight with the landing gear and flaps up, using the entry airspeed recommended in the pilot's operating handbook or maneuvering speed (V_A), whichever is slower.
- Establish a coordinated turn not to exceed 30° of bank. Then, simultaneously apply back elevator pressure to begin a climb and smoothly apply full power. If your airplane has a constant speed propeller, increase the RPM to the climb or takeoff setting, then advance the throttle to the climb setting.



Chandelles - Procedure

- Begin a gradual reduction of bank angle, while maintaining a constant pitch attitude.
- Reduce the pitch attitude to resume a level flight attitude, allowing your airplane to accelerate while maintaining a constant altitude.

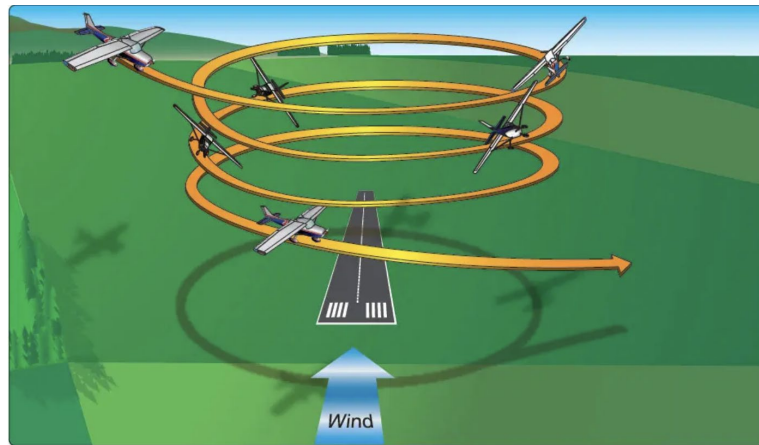


Chandelles - Video



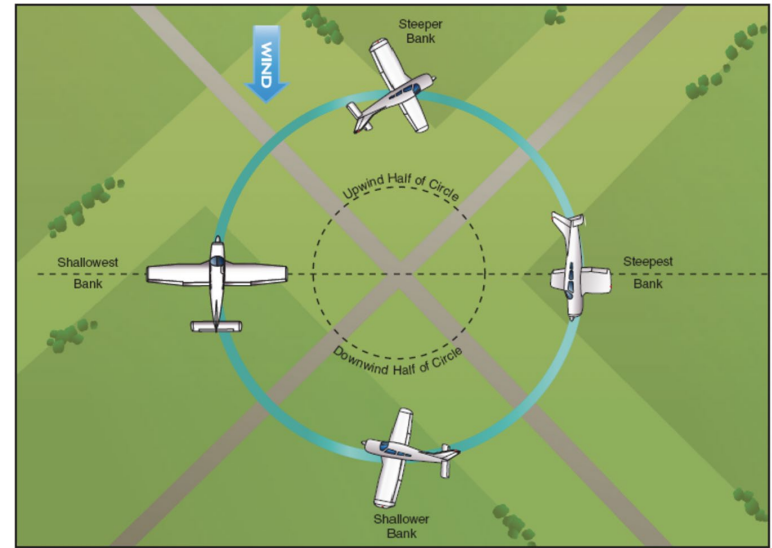
Steep Spiral

A steep spiral is a maximum performance maneuver that requires you to combine a steep-spiraling descent with the basic elements of turns about a point. The maneuver is invaluable for teaching you coordination, planning, orientation, aircraft control, corrections for wind effect, and division of attention. Like other performance maneuvers for commercial pilot certification, a steep spiral is rarely performed during routine flight operations. It does, however, provide you with practical skills that can be used when a no-power descent must be performed within a tight radius due to surrounding terrain or clouds.



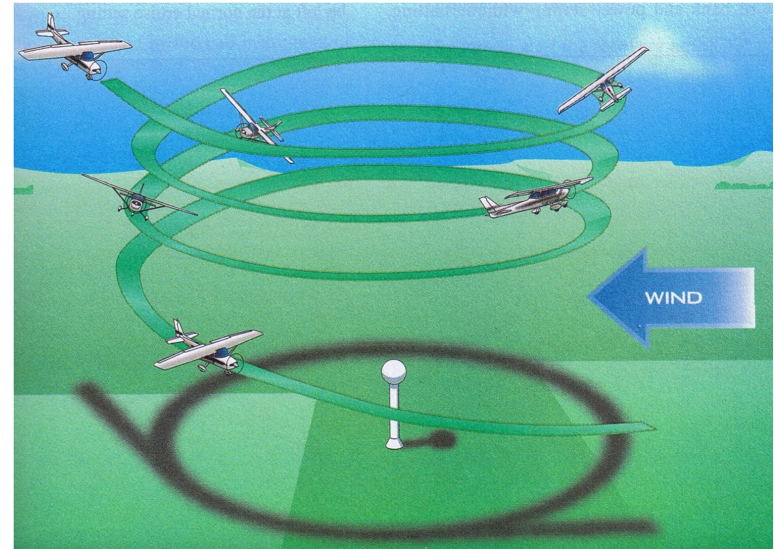
Steep Spiral

The maneuver consists of a minimum of three, uniform-radius, 360 degree turns around a ground reference point. To maintain a constant radius, the bank angle is varied to adjust for wind effect. At the steepest part, you should achieve a bank angle of approximately 50° , but never greater than 60° of bank. For increased practical application, after rolling out of the spiral, a downwind, base, and final approach pattern may be added to simulate an approach to an emergency landing.



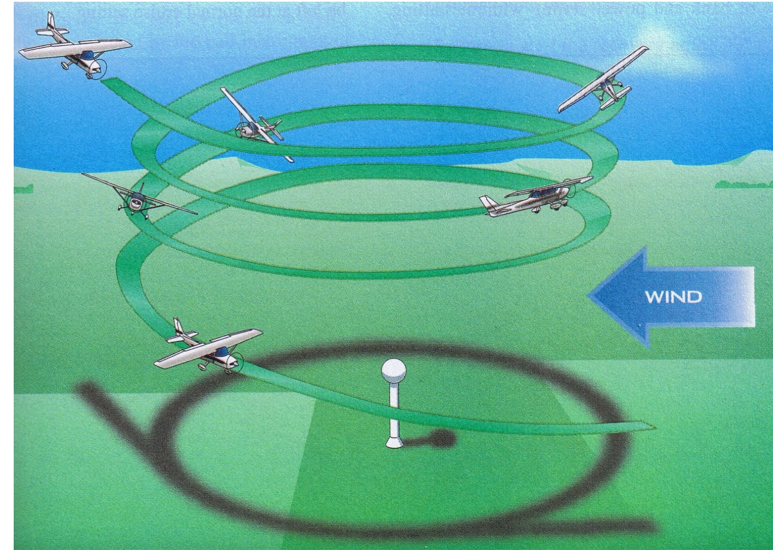
Steep Spiral - Procedure

- When you are established at the correct entry altitude, perform your clearing turns. Remember that you will be descending rapidly, so clear the area above, below, and around your aircraft.
- Select a suitable ground reference point that is distinct and easily seen.
- With the reference point chosen, position the aircraft so it will pass within 1/4 mile of the point on the downwind side.
- As you approach the reference point, configure the airplane with the landing gear and flaps up. Adjust power and pitch to obtain the proper entry airspeed recommended by the aircraft manufacturer, or if one is not prescribed, use a speed that is at or below maneuvering speed (VA).



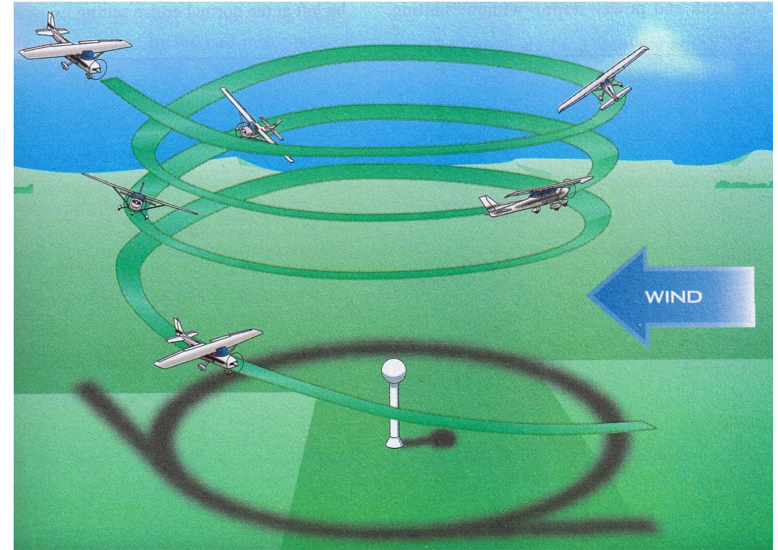
Steep Spiral - Procedure

- As you continue toward the upwind side of the spiral turn, gradually reduce your angle of bank to compensate for the effects of the wind.
- Once on the upwind side of the turn, you are at the shallowest bank angle of the spiral turn, and you are exerting the least amount of backpressure on the flight controls. Your bank angle and back pressure slowly increases as you continue a turn toward the downwind side of the spiral.



Steep Spiral - Procedure

- As you approach the original entry point, briefly advance the throttle to clear the engine and then return it to idle.
- Once you have completed three complete rotations, roll out within 100 of the entry heading.
- While it is not specified in the PTS, your flight instructor or designated examiner may ask you to perform a steep spiral and, upon roll out, immediately execute an emergency approach and landing. Typically, upon rollout of the spiral, you would be established on the downwind leg, ready to make a turn to base and then final for the emergency (simulated) landing.



Steep Spiral - Video

