

X.B. S-Turns Across a Road

Objectives	The student should develop knowledge of the elements related to S-turns as necessary in the Private Pilot ACS.
Key Elements	<ul style="list-style-type: none">✦ Wind correction✦ Coordination✦ Emergency landing area
Elements	<ul style="list-style-type: none">✦ Selecting a suitable altitude✦ Selecting a suitable reference line✦ The basics✦ Prior to entry✦ The maneuver✦ Coordination
Schedule	<ol style="list-style-type: none">1. Discuss objectives2. Review material3. Development4. Conclusion
Equipment	<ul style="list-style-type: none">✦ White board✦ Markers✦ References
Instructor's Actions	<ol style="list-style-type: none">1. Discuss lesson objectives2. Present lecture3. Questions4. Homework
Student's Actions	Participate in discussion Take notes
Completion Standards	The student understands the effects of wind on maintaining equilateral radii on each side of a reference line, and is able to make the necessary adjustments throughout the turns due to the airplane's changing position in relation to the wind.
References	FAA-H-8083-3B, <i>Airplane Flying Handbook</i> (Chapter 6)

Instructor Notes

Introduction

Overview—review objectives and key ideas.
Why—to develop the ability to compensate for drift during turns, orient the flightpath with ground references, follow an assigned ground track, arrive at specified points on assigned headings, and divide the pilot's attention.

Selecting a suitable altitude

Entry altitude should be 600-1000' AGL.
Maneuver restrictions are $\pm 100'$. At 600' AGL, there is no room for error below, and at 1,000' AGL, there is no room for error above—800' AGL is a good altitude for the maneuver.

Selecting a suitable reference point

Choose a straight ground reference line or road that lies 90° to the direction of the wind. Road, fence, railroad tracks, section line—easily identifiable and sufficiently long to make a series of turns.
Make sure it is away of populated areas, obstructions, and anything that could pose a hazard.
Allow for a nearby landing area in case of an emergency during the maneuver. Select a reference field and an emergency area.

Estimate wind direction (METAR, smoke, water, or do a 360° to note the ground track).

CE—selecting a ground reference without a suitable emergency landing area within gliding distance.

The basics

Maneuver: cross the road at 90° and directly begin a series of 180° turns of uniform radius in opposite directions, re-crossing the road at a 90° angle at the completion of each turn. Change bank constantly to track a constant radius turn on each side of the reference line.

Constant radius track—change roll rate and angle of bank as groundspeed changes. Steepest bank on downwind, gradually shallowed while approaching upwind.

Roll airplane from one bank directly to the opposite as you cross the ground reference.

Divide attention between ground track and airplane. Watch ground reference line, maintain ground track, fly the airplane, cross check the instruments, and watch for other traffic.

CE—poor planning, orientation, or division of attention.

CE—failure to obtain the constant change of bank required to obtain a semicircular track.

- CE—not selecting a good reference line.
- CE—not identifying wind direction.
- CE—poorly maintained ground track, airspeed, and altitude.

Prior to entry

- ✦ Pre-maneuver checklist: Lights ON; Fuel Pump ON; Mixture FULL RICH; Gauges GREEN
- ✦ Clearing turns
- ✦ Airspeed: trim for hands of level flight

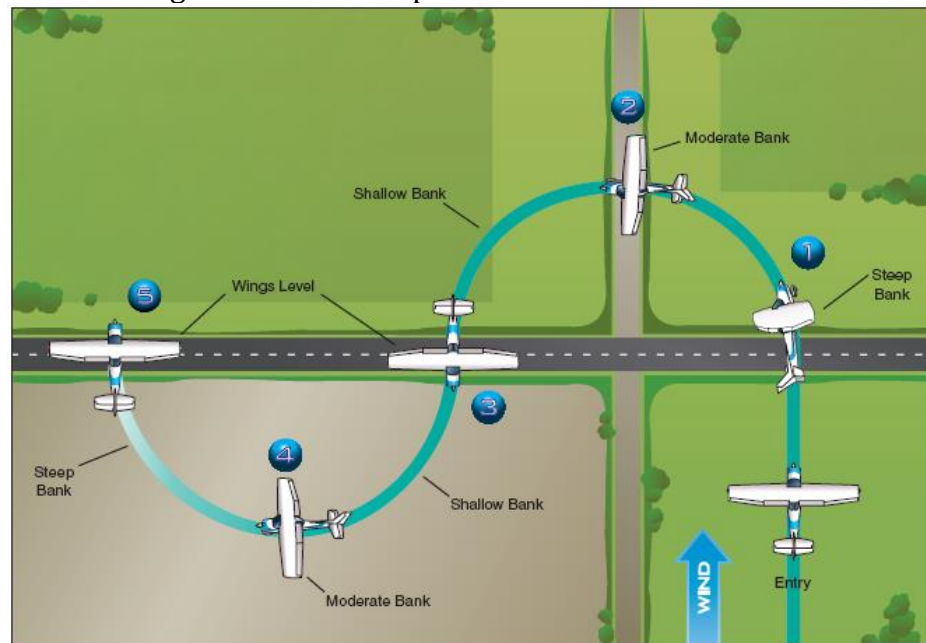
The maneuver

Entry—approach the reference line on the downwind, perpendicular to the line, at 800' AGL.

CE—faulty entry procedure.

As soon as the lateral axis of the airplane is over the line, roll into the steepest bank fairly rapidly. If the initial bank is too shallow, you will be pushed away from the line, resulting in an excessive radius.

Visualize the ground track and plan for the wind's effect on the track.



Downwind side—when the plane is on a downwind, groundspeed is greatest, and it will be departing from the road quickly. A fairly steep bank will attain the proper crab angle and prevent the plane from flying too far from the road.

In the first half of the turn (90°), the heading changes from a tailwind to a crosswind—crab angle is greatest at the 90° point. Groundspeed decreases progressively and the rate of departure from the road decreases, so we can decrease the bank.

In the second half of the turn, the heading changes to a headwind, decreasing the groundspeed and the rate of closure with the road—slowly shallow the bank during the remaining 90° to remove the crab completely.

Wings level as the turn is completed directly over the road.

Upwind side—start a turn in the opposite direction at the instant the road is crossed. Flying directly into a headwind with a low groundspeed—start with a shallow bank, avoiding an excessive rate of turn that would result in a small radius.

Angle of bank should establish a ground track with an equal radius to the previous turn. The first semicircle establishes the radius.

CE—having an asymmetrical ground track.

Groundspeed is increasing—after 90° of turn, the rate of closure with the road will increase rapidly, so progressively increase the bank angle.

Time the rollout so that the plane is straight and level perpendicularly to the road—judge the closure rate and increase bank to cross wings level.

CE—improper correction for wind drift

Not changing the bank will result in too small or too large of a semicircle. There may be a tendency to increase the bank too rapidly during the initial upwind turn, preventing the completion of the 180° turn before re-crossing the road.

Maintain a constant altitude throughout the maneuver by adjusting back pressure as bank is increased/decreased. This should result in a maintained airspeed (± 10 knots) as long as bank doesn't get too steep. Check the airspeed indicator and make small power adjustments if necessary.

Do not exceed 45° of bank—this will keep the increased load factor from affecting airspeed.

CE—failure to maintain selected altitude or airspeed.

Coordination

Maintain coordinated flight throughout the changing bank.

CE—uncoordinated flight control application.

Uncoordinated flight control application may occur if the pilot fixates on the ground reference line. Don't yaw the nose to be directly over the reference line.

Equations

$$\text{Rate of turn} = 1091 \times \frac{\tan(\text{bank angle})}{\text{velocity}} \text{ [degrees per second]}$$

$$\text{Radius of turn} = \frac{v^2}{11.26 \tan(\text{bank angle})} \text{ [feet]}$$

Common errors

- ✦ Faulty entry procedure
- ✦ Poor planning, orientation, or division of attention
- ✦ Uncoordinated flight control application
- ✦ Improper correction for wind drift
- ✦ An unsymmetrical ground track
- ✦ Failure to maintain selected altitude or airspeed
- ✦ Selection of a ground reference line without a suitable emergency landing area in gliding distance

Conclusion

Brief review of main points.

Bank is constantly changing to track a constant radius turn on each side of the reference line, as the airplane's position relative to the wind is changing.

CFI PTS

Objective: To determine that the applicant:

1. Exhibits instructional knowledge of the elements of S-turns across a road by describing:
 - a. The purpose of S-turns across a road and their relationship to basic/advanced airmanship skills.
 - b. How to select a suitable altitude.
 - c. How to select a suitable ground reference line with consideration given to emergency landing areas.
 - d. Orientation, division of attention, and planning.
 - e. Configuration and airspeed prior to entry.
 - f. Entry procedure.
 - g. Wind drifts correction.
 - h. Tracking of semicircles of equal radii on either side of the selected ground reference line.
 - i. How to maintain desired altitude and airspeed.
 - j. Turn reversal over the ground reference line.
 - k. Coordination of flight controls.
2. Exhibits instructional knowledge of common errors related to S-turns across a road by describing:
 - a. Faulty entry procedure.
 - b. Poor planning, orientation, or division of attention.
 - c. Uncoordinated use of flight controls.
 - d. Improper correction for wind drift.
 - e. An unsymmetrical ground track.
 - f. Failure to maintain selected altitude or airspeed.
 - g. Selection of a ground reference line where there is no suitable emergency landing area within gliding distance.
3. Demonstrates and simultaneously explains S-turns across a road from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to S-turns across a road.

PPL ACS

Objective: To determine that the applicant:

1. Exhibits knowledge of the elements related to S-turns.
2. Selects a suitable ground reference line.
3. Plans the maneuver so as to enter at 600 to 1,000' AGL, perpendicular to the selected reference line.
4. Applies adequate wind-drift correction to track a constant radius turn on each side of the selected reference line.
5. Reverses the direction of turn directly over the selected reference line.

6. Divides attention between airplane control and the ground track while maintaining coordinated flight.
7. Maintains altitude, ± 100 feet (30 meters); maintains airspeed, ± 10 knots.