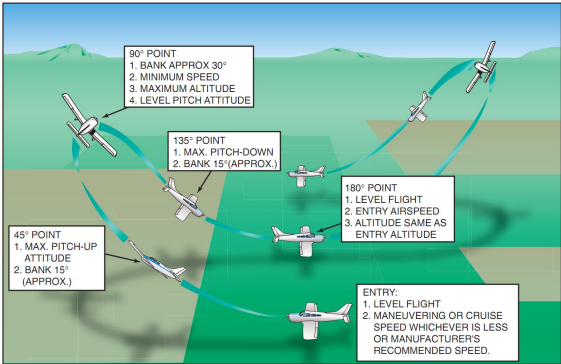


# Lazy Eights

<p><b>Objective</b></p>	 <p>The diagram illustrates the lazy eight maneuver with the following callouts:</p> <ul style="list-style-type: none"> <li><b>90° POINT:</b> 1. BANK APPROX 30°, 2. MINIMUM SPEED, 3. MAXIMUM ALTITUDE, 4. LEVEL PITCH ATTITUDE</li> <li><b>135° POINT:</b> 1. MAX. PITCH-DOWN, 2. BANK 15° (APPROX.)</li> <li><b>180° POINT:</b> 1. LEVEL FLIGHT, 2. ENTRY AIRSPEED, 3. ALTITUDE SAME AS ENTRY ALTITUDE</li> <li><b>45° POINT:</b> 1. MAX. PITCH-UP ATTITUDE, 2. BANK 15° (APPROX.)</li> <li><b>ENTRY:</b> 1. LEVEL FLIGHT, 2. MANEUVERING OR CRUISE SPEED WHICHEVER IS LESS OR MANUFACTURER'S RECOMMENDED SPEED.</li> </ul>
<p>To ensure the applicant understands and can exhibit a clear understanding of the lazy eights maneuver and how to perform it properly.</p>	
<p><b>Purpose</b></p>	
<p>The lazy eights maneuver combines several aerodynamic concepts such as overbanking tendency, changing rate of turn, and the left-turning tendencies with a requirement to maneuver according to a set of ground references. Mastery of the lazy eights maneuver develops smooth, coordinated, precise aircraft control throughout a wide range of aircraft speeds and attitudes, while constantly monitoring outside visual references.</p>	
<p><b>Schedule</b></p>	<p><b>Equipment</b></p>
<ul style="list-style-type: none"> <li>● <b>Ground Lesson:</b> 15 minutes</li> <li>● Initial             <ul style="list-style-type: none"> <li>■ <b>Flight 1:</b> 30 minutes - <i>Introduction to Maneuver</i></li> <li>■ <b>Flight 2:</b> 30 minutes - <i>Improve Proficiency (Dual)</i></li> </ul> </li> <li>● Solo             <ul style="list-style-type: none"> <li>■ <b>Flight 3:</b> 30 minutes - <i>Improve Proficiency</i></li> </ul> </li> <li>● Pre-Checkride             <ul style="list-style-type: none"> <li>■ <b>Flight 4:</b> 20 minutes - <i>Demonstrate Proficiency</i></li> </ul> </li> <li>● <b>Debrief:</b> 10 minutes (<i>per flight</i>)</li> </ul>	<ul style="list-style-type: none"> <li>● n/a</li> </ul>
<p><b>Student Actions</b></p>	<p><b>Instructor Actions</b></p>
<ul style="list-style-type: none"> <li>● Ask any questions, receive study material for the next lesson.</li> <li>● Watch linked video.</li> <li>● Review listed references.</li> </ul>	<ul style="list-style-type: none"> <li>● Deliver the ground lesson (below).</li> <li>● Demonstrate the maneuver in flight.</li> <li>● Debrief after each flight.</li> </ul>
<p><b>Completion Standards</b></p>	
<ul style="list-style-type: none"> <li>● <b>Ground:</b> Student can explain the purpose of the maneuver and how to execute it properly.</li> <li>● <b>Flight:</b> Student can perform the maneuver to the applicable ACS standards.             <ul style="list-style-type: none"> <li>● See expanded Completion Standards below.</li> </ul> </li> </ul>	

## References

- The Finer Points - “How to REALLY fly a Lazy Eight”
  - YouTube - <https://www.youtube.com/watch?v=6oQOUiHhjaY>
- FAA-H-8083-3B (Airplane Flying Handbook) - Chapter 9, Page 6 [Maneuver Description], Chapter 3, Page 12-14 [Turn Radius, Overbanking Tendency]
- FAA-H-8083-25B (Pilot’s Handbook of Aeronautical Knowledge) - Chapter 5, Page 30-33 [Left Turning Tendencies], Chapter 5, Page 41 [Turn Radius], Chapter 5, Page 20 [Spiral Instability]
- FAA-S-ACS-7A (Commercial Pilot ACS) - Area V Task D
- FAA-S-8081-6D (CFI PTS) - Area IX Task D

## Ground Lesson Outline

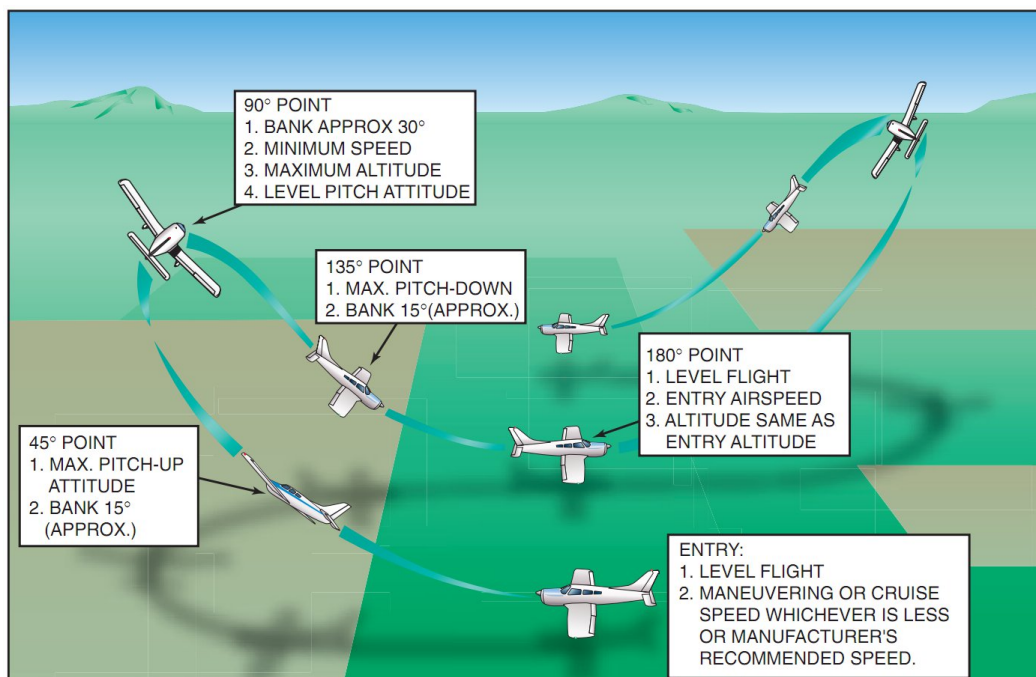
- What is a Lazy Eight?
- Visual References
  - 45, 90, 135 degree points
- Overbanking Tendency
- Left Turning Tendencies
  - Especially P-Factor, due to the high Angle of Attack
- Safety considerations
  - Use of checklists
  - Visual traffic scanning
- Maneuver Description - step-by-step
  - Entry position, airspeed, etc.
- Expanded Completion Standards

## Common Errors

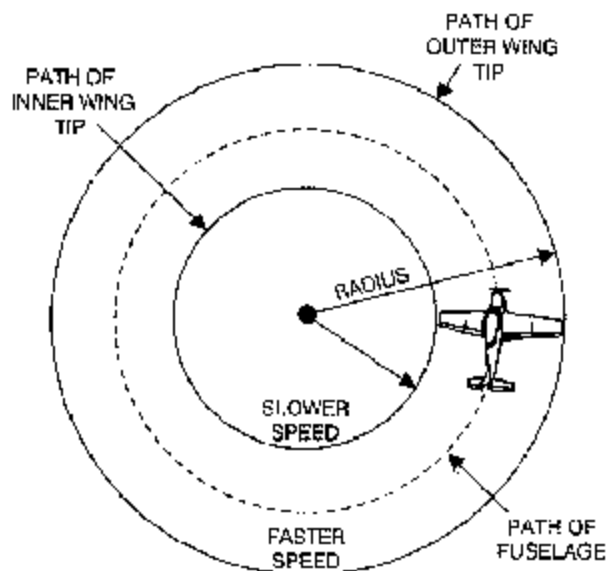
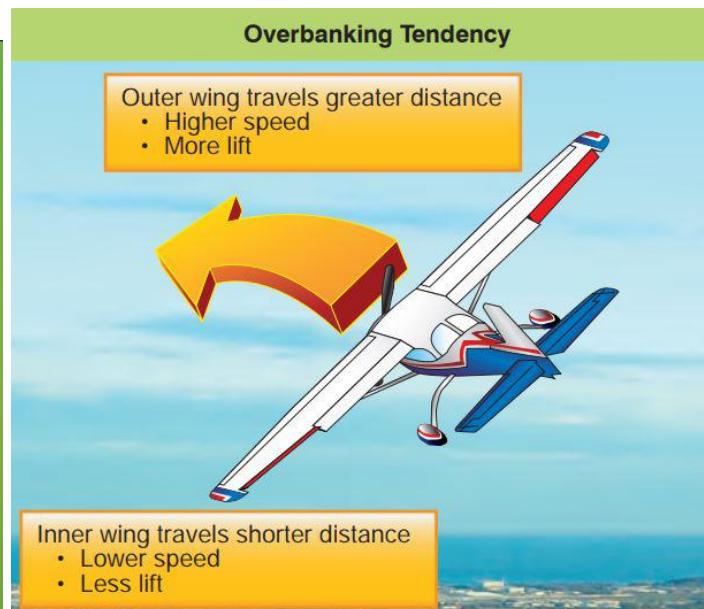
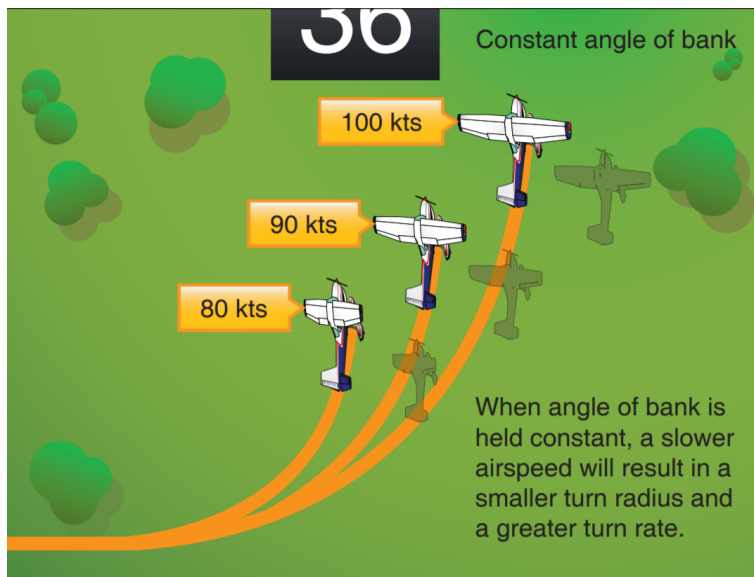
- Not clearing the area
- Maneuver is not symmetrical across each 180°
- **Inadequate or improper selection or use of 45°, 90°, 135° references**
- Ineffective planning
- **Gain or loss of altitude at each 180° point**
- **Poor control at the top of each climb segment resulting in the pitch rapidly falling through the horizon**
- Airspeed or bank angle standards not met
- Control roughness
- **Poor flight control coordination**
- **Stalling at any point during the maneuver**
- Execution of a steep turn instead of a climbing maneuver
- Not scanning for other traffic during the maneuver
- **Performing by reference to the flight instruments rather than visual references**

## Ground Lesson Content

- **What is a Lazy Eight?** - The lazy eights maneuver can be thought of as a modified version of the S turns across a road maneuver. The maneuver is modified by a gentle pitch up during each turning portion, with the aircraft tracing out a symmetrical 'S' shape with the curves lifted up.



- **Visual References** - The lazy eight maneuver is best visualized when performed across a reference line on the ground, such as a road. The maneuver requires 3 prominent ground reference points, usually chosen near the horizon and far from the aircraft. As the turn progresses towards each point, the pilot smoothly varies aircraft attitude, speed, and altitude to meet these targets:
  - **Start** - Cross reference line perpendicular and level, at or below  $V_a$ . Begin with small bank (< 5 degrees), begin pitch up
  - At the **45 degree** reference - Maximum pitch up, approx 15 degrees bank, speed decaying
  - At the **90 degree** reference - Approx 30 degrees bank, level pitch (nose falling through horizon), speed just above stall, altitude maximum
  - At the **135 degree** reference - Maximum pitch down, approx 15 degrees bank, speed increasing.
  - At the **180 degree** point (crossing the reference line) - Level, speed and altitude same as the Start. *Repeat turn in the opposite direction*, using the 135 degree point as the 45 point, the same 90 degree point, and the 45 degree point as the 135 degree point. Properly executed lazy eights produce **symmetrical loops** in either direction.
- **Overbanking Tendency** - During the pitch up portion of the lazy eights, the airspeed decays as the plane turns gently, which causes the rate of turn to increase rapidly. This increase in turn rate causes a **pronounced overbanking tendency**, as the outside wing is now traveling significantly faster than the inboard wing, producing more lift.



- Because of this overbanking tendency, the lazy eight can be flown by starting with only a very small bank angle, approximately 5 degrees or less. As the airplane pitches up and slows, this 5 degrees of bank will tend to increase to the target 30 degrees of bank, *without any aileron input at all*.
- **Left Turning Tendencies** - At the top of the turns, the airplane should be very close to stall speed, flying with high angle of attack, and a cruise power setting. This causes the left-turning tendencies of torque, slipstream, and especially P-factor to be very pronounced. This means that maintaining coordination throughout the maneuver will require strong rudder pressure at the highest points, especially when the maneuver turns to the right.

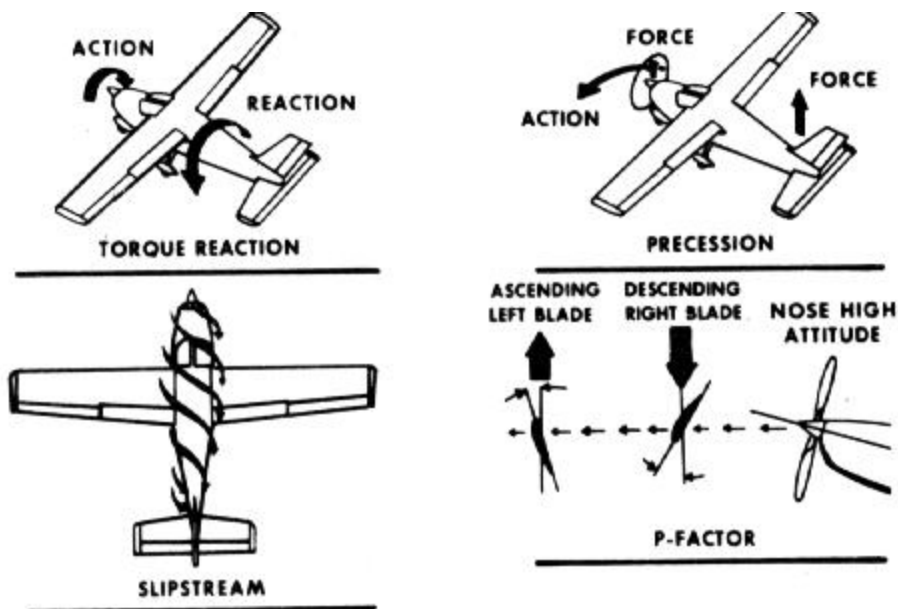


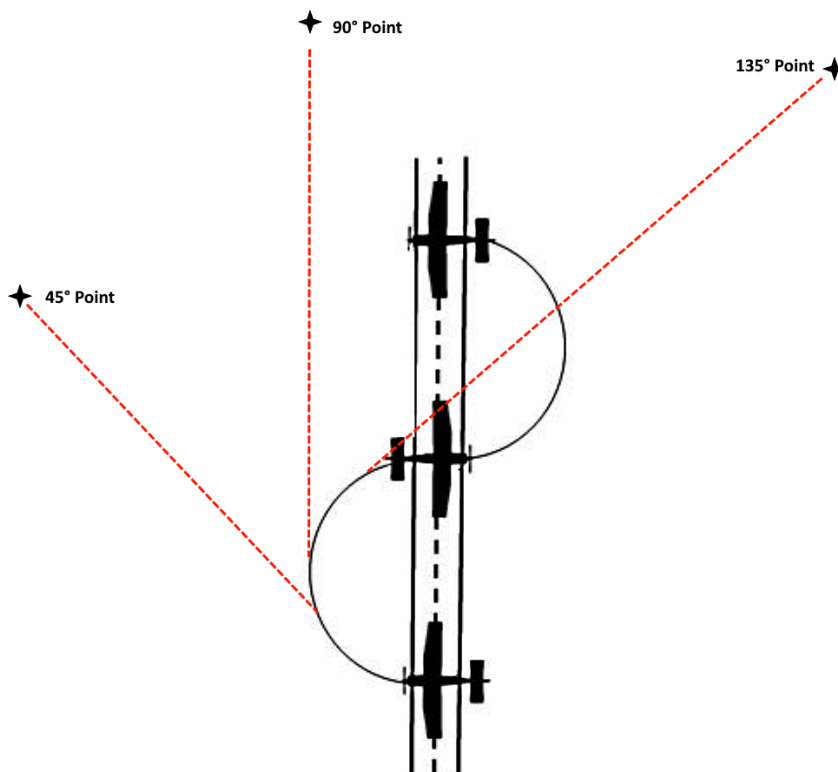
Figure 3-6 Left Turning Tendencies

- **Safety Considerations**

- **Checklists** - Pilots should complete a pre-maneuver checklist before beginning the maneuver.
- **Visual Traffic Scanning** - Pilots must remember to keep up their traffic scan throughout the maneuver.

### Maneuver Description

- **Selecting Ground References** - Select a prominent road or other straight line feature, which is easy to identify and is clear of hazards on the ground. The point should ideally be something like a road or a canal in an unpopulated area. Do not plan to maneuver over houses or other structures which could cause a nuisance. As you prepare to enter the maneuver, select 3 prominent points far away from the aircraft, near the horizon. One point should be at the 45 degree position, one point at the 90 degree position (along the reference line, towards the horizon), and a 135 degree position (45 degrees behind).



- **Entry Position and Heading** - Aim to begin the maneuver at one end of the reference line (road, canal, etc), crossing perpendicular to the line. The aircraft should be properly configured before this point, such that the turn can begin immediately upon crossing the reference line.
- **Entry Altitude** - A lazy eight should be *completed no lower than 1,500ft* AGL. As the loops of the maneuver progress, you may end up slightly lower than your starting altitude, therefore, an entry altitude of at least *2,000ft* AGL should be planned.
- **Entry Airspeed** - Like all performance maneuvers, lazy eights must be started at less than **V<sub>a</sub>** (maneuvering speed). Typically lazy eights are entered in level cruise flight, at least 5-10 knots below V<sub>a</sub>.
- **Bank Angle** - The bank angle will vary continuously throughout the maneuver, but should at maximum be approximately **30 degrees**.
- **Pitch Angle** - The pitch angle will vary continuously through the maneuver, but should be at maximum be approximately **20 degrees** nose up and **20 degrees** nose down. The pitch chosen should result in the airplane being very slow, near stall speed, at the highest, 90 degree points of the maneuver. *It is important to not overpitch either up or down during the maneuver*, as the airspeed can decay to a power-on stall at the highest point, or exceed V<sub>a</sub> at the lowest point. It will require some practice to determine the rate of pitch, and the highest pitch required to make the turn work out.
- **Recovery** - When completing the second loop, airspeed, altitude, and heading should be approximately the same as the maneuver entry. Recover to normal cruise flight.
- **Coordination** - Proper coordination is essential to the lazy eights maneuver and should be maintained *at all times*. Right rudder pressure will be significant, especially midway through the right-turning loop. Failure to apply adequate rudder pressure can result in an uncoordinated power-on stall, which can lead to entering a spin.
- **This is a visual maneuver!** Eyes should remain outside the cockpit as much as possible to scan for traffic and ensure proper aircraft attitude as the maneuver moves through each of the ground reference points.

## Expanded Completion Standards

- The pilot can explain the purpose of the lazy eights maneuver and how the various factors affect the performance of the maneuver.
- The pilot can perform the maneuver to the following standards:
  - Pilot clears the area, performs a pre-maneuver checklist, establishes a speed below  $V_a$ , and selects an altitude that will allow the maneuver to be performed no lower than 1,500 feet above ground level (AGL).
  - Pilot maintains coordinated flight throughout the maneuver.
  - Pilot complete the maneuver in accordance with the following:
    - Approximately  $30^\circ$  bank at the steepest point (90 degree reference)
    - Constant change of pitch and roll rate and airspeed
    - Altitude at  $180^\circ$  point,  $\pm 100$  feet from entry altitude
    - Airspeed at the  $180^\circ$  point,  $\pm 10$  knots from entry airspeed
    - Heading at the  $180^\circ$  point,  $\pm 10^\circ$
  - Pilot continues the maneuver through the number of symmetrical loops specified, then resumes straight-and-level flight.