Task IX.D: Lazy Eights

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Lesson Overview

Objective

The student should understand the elements and necessary control inputs to perform the lazy eight maneuver. The student should show the ability to perform a coordinated, well planned and oriented lazy eight as prescribed in the ACS/PTS.

Reference

- Aircraft Flight Manual / Pilot's Operating Handbook
- Airplane Flying Handbook

Key Elements

1. Transfer of Energy
2. Constantly changing control pressures
3. Symmetry

Elements

1. Relating the Maneuver
2. Performing the Lazy Eight
3. Rudder Control
4. Summary

Equipment

1. White board and markers
2. References
3. iPad

Instructor Actions

1. Discuss lesson objectives
2. Present Lecture
3. Ask and Answer Questions
4. Assign homework

Student Actions

1. Participate in discussion
2. Take notes
3. Ask and respond to questions

Schedule

1. Discuss Objectives
2. Review material
3. Development
4. Conclusion

Completion Standards

The student understands the elements involved in performing a lazy eight and has the ability to perform the lazy eight on their own.

Instructor Notes

Attention

Who wants to be a crop duster when they grow up? This is the maneuver you have to know if you want to crop dust. And, although challenging, it's a pretty fun maneuver.

Overview

Review Objectives and Elements/Key ideas

What

A maneuver consisting of two 180° turns in opposite directions, while making a climb and descent in a symmetrical pattern during each of the turns. It is designed to develop perfect coordination of controls through a wide range of airspeeds and altitudes so that certain accuracy points are reached with planned attitude and airspeed. It is the only standard flight training maneuver during which at no time do the forces on the controls remain constant.

Why

The lazy eight develops perfect coordination of the controls through a wide range of airspeeds and altitudes. It is a great trainer because of the constantly varying forces and attitudes required. It also helps develop subconscious feel, planning, orientation, coordination, and speed sense.

Lesson Details

The maneuver can be compared to a "half pipe" where the pipe is ridden up one side, a turnaround occurs, then down the pipe and back up the other side ... with another turnaround to do it all over again. There is a transfer of energy as the pipe is ascended, then transfered again when descending.

This is referred to by many pilots as the "cropdusting maneuver".

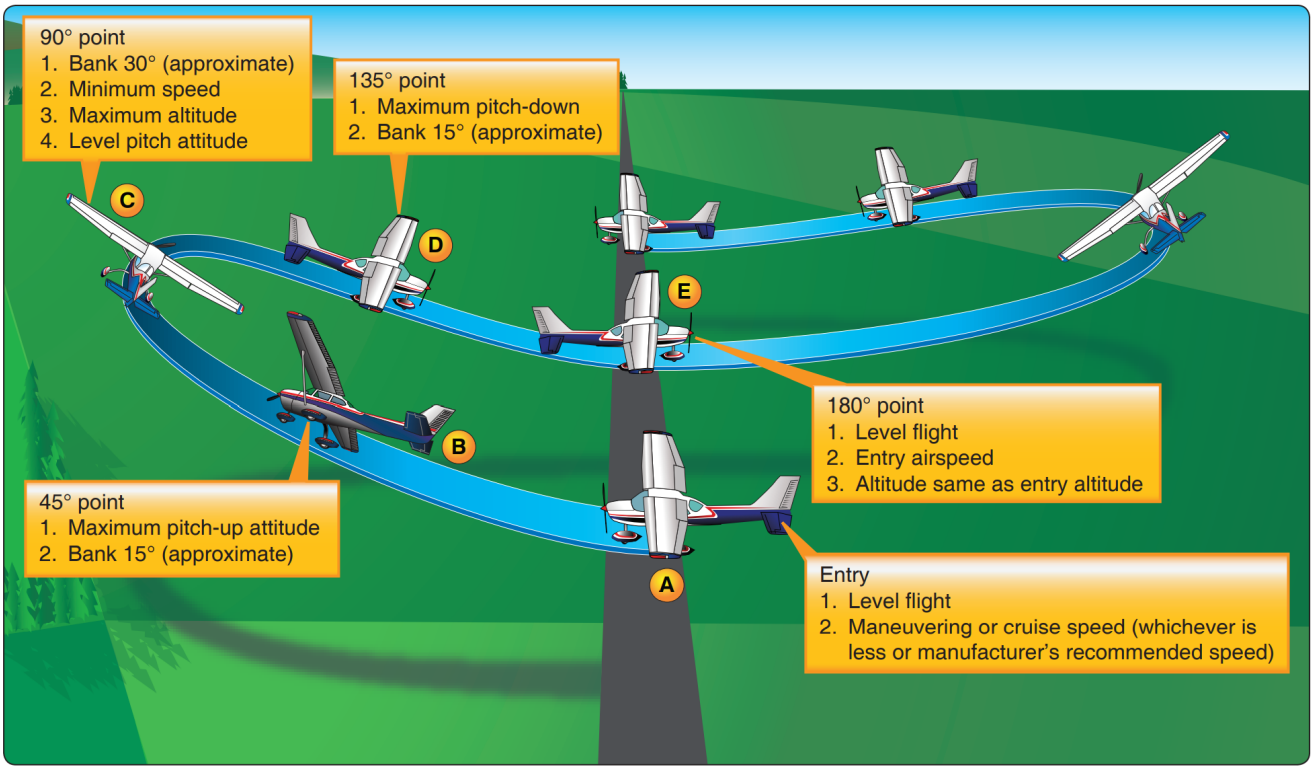

Figure 9-4. *Lazy eight.*

Performing the Lazy Eight

Before Starting

1. Select an altitude
    a. No lower than 1,500’ AGL
2. Pre-maneuver checklist
3. Ensure the area is clear of traffic
4. The airplane should be in straight and level flight at cruise power, at or below Va
5. Choose visual reference points at 45 degree, 90 degree, and 135 degree in the direction the turn will be in
    a. Common Error - Poor selection of reference points
        i. Select reference points that are easily identified
        ii. Don’t use points that are too close to your position, ensure that they are toward or on the horizon

Starting the Lazy Eight

1. The maneuver is started from straight and level flight with a gradual climbing turn in the direction of the 45 degree reference point
2. VERY gently begin a climb and turn to each reach 15 degrees of pitch (max pitch) and bank at the 45 degree point.
    a. Pitch must be increased faster than bank. As pitch is increased airspeed decreases and therefore the rate of turn increases. Since the bank is also being increased, the rate of turn is further increasing.
    b. Unless the maneuver is started with a very slow rate of roll, the combination of increased pitch and increasing bank will cause the rate of turn to be so rapid the 45 degree point will be reached before the highest pitch attitude. Decreasing airspeed also means increased torque, right rudder will be necessary to maintain coordination.
3. At the 45° point the pitch attitude should be at maximum (15°), the angle of bank should be at 15°. At this point the pitch attitude should start to decrease

At the 45 degree point

1. The pitch attitude should be at maximum (15 degree)
2. The angle of bank should be at 15 degree and continue to increase at the same rate
3. The pitch attitude should start to decrease slowly toward the horizon and the 90 degree reference point

Since the airspeed is still decreasing, right rudder pressure will be required to counteract the left turning tendencies of the aircraft. As the airspeed slows, the rudder becomes less effective.

45 degree to 90 degree point

1. Continue to increase angle of bank to a max of 30° at the 90° point.
    a. Bank continues to increase at the same rate as the first 45° of turn, and should conclude with no more than 30° of bank.
2. Pitch continues to decrease to pass through level flight at the 90° point.
    a. As the aircraft continues to slow increasing right rudder will be needed
3. At the 90° point the bank should be at the maximum (30°) for the entire maneuver.

The airplane should be turning very slowly, and opposite aileron may be needed to maintain the bank angle. This is OK as long as the aircraft remains coordinated. Airspeed should be at a minimum (about 5 to 10 knots above stall), therefore rudder required will be at its highest. Pitch should be for level flight, and the aircraft will transition into a descending turn.When passing through the 90° point the bank should be decreased gradually and the nose be allowed to continue lowering.

Guide don’t dive.

90 degree to 135 degree point

1. Allow the bank to continue to decrease to reach 15° of bank at the 135° point
2. Allow pitch to decreased to reach the maximum pitch down at 135°, which is roughly 5° to 7°
    a. This is less than the max pitch up since the aircraft has gravity, thrust, and a forward component of lift working together to bring the aircraft down.
3. Allow airspeed to increase during the descending turn, which will require that the rudder and aileron pressure be relaxed
4. At the 135° point the nose of the aircraft should be at the lowest pitch attitude (5° to 7°), the bank angle should be 15°, and the airspeed should be increasing

135 degree to 180 degree point

1. Continue to decrease the bank to level the wings
    a. Note the amount of turn remaining and adjust the rate of rollout and pitch change so the wings become level and the original airspeed attained in level flight as the aircraft reaches the 180° point
2. Continue to increase pitch to bring the nose back to the horizon
    a. Altitude should end up back at the maneuver entry altitude. If the aircraft was crop dusting then coming in too high and the "dust" would be scattered by the wind, if too low it could hit the ground, and if off heading it won't achieve even coverage .. and in any of those cases it is going to make a mess

At the 180° point

1. Upon returning to the starting altitude and at the 180° point a climbing turn should be started immediately in the opposite direction using the same visual references.
2. The progression through the next turn should mimic the first as closely as possible

Rudder Control

Due to decreasing airspeed during the climbing portion of the maneuver considerable rudder pressure will be needed to remain coordinated. This will be required to counteract torque at the top of the eight in both the left and right turns. The pressure is greatest at the top of the turns.

More pressure will be needed at the top of the climbing right turn due to more torque correction being needed in the right turn. In the climbing right turn the controls might end up slightly crossed due to the need for left aileron pressure to prevent overbanking and right rudder to overcome the torque.

Finally, this is not a ground reference maneuver. It is worthwhile to have some sort of reference on the ground to help with orientation, but it is not critical to .. say .. cross the road used as a reference right at the 180° point on every iteration. Doing so can force either a period of straight and level which squanders energy, or a rush to the straight and level portion which may serve to cause the aircraft to miss either the target airspeed or altitude.

Summary

It is not possible to perform a lazy eight maneuver mechanically due to the fact that the control pressures required for perfect coordination are never exactly the same. The maneuver requires constant changing control pressures and at no time is the maneuver flown straight and level. The control pressures change in accordance with the varying combinations of climbing and descending turns at varying airspeeds.

Common Errors

- Poor selection of reference points
- Uncoordinated use of flight controls
- Unsymmetrical loops resulting from poorly planned pitch and bank attitude changes
- Inconsistent airspeed and altitude at key points
- Loss of orientation
- Excessive deviation from reference points

Conclusion

It is important that each part of the maneuver is performed at the same speed, or, increases and decreases in both pitch and bank should be made at the same rate during each part of the turn. Each part of the turn should be a mirror image of its opposite. It also is very important to keep the airplane coordinated throughout the varying attitudes and airspeeds in the maneuver.

ACS Requirements

CFI PTS Standards

To determine that the applicant

1. Exhibits instructional knowledge of the elements of lazy eights by describing:
    a. The purpose of lazy eights and their relationship to basic/advanced airmanship skills.
    b. Selection of entry altitude.
    c. Selection of suitable reference points.
    d. Entry airspeed and power setting.
    e. Entry procedure.
    f. Orientation, division of attention, and planning.
    g. Coordination of flight controls.
    h. Pitch and bank attitudes at key points during the maneuver.

i. Importance of consistent airspeed and altitude control at key points during the maneuver.
j. Proper correction for torque effect in right and left turns.
k. Loop symmetry.

2. Exhibits instructional knowledge of common errors related to lazy eights by describing:
   a. Poor selection of reference points.
   b. Uncoordinated use of flight controls.
   c. Unsymmetrical loops resulting from poorly planned pitch and bank attitude changes.
   d. Inconsistent airspeed and altitude at key points.
   e. Loss of orientation.
   f. Excessive deviation from reference points.
3. Demonstrates and simultaneously explains lazy eights from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to lazy eights.

Commercial Pilot ACS Skills Standards

1. Clear the area.
2. Select an altitude that will allow the maneuver to be performed no lower than 1,500 feet AGL.
3. Establish the recommended entry configuration, power, and airspeed.
4. Maintain coordinated flight throughout the maneuver.
5. Complete the maneuver in accordance with the following:
   a. Approximately 30° bank at the steepest point
   b. Constant change of pitch and roll rate and airspeed
   c. Altitude at 180° point, ±100 feet from entry altitude
   d. Airspeed at the 180° point, ±10 knots from entry airspeed
   e. Heading at the 180° point, ±10 degrees
6. Continue the maneuver through the number of symmetrical loops specified, then resume straight-and-level flight.