

Task IX.C: Chandelles

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Lesson Overview

Objective

The student should be able to complete a Chandelle taking into account the changing airspeed and maneuver as prescribed in the ACS/PTS.

Reference

- Airplane Flying Handbook (FAA-H-8083-3B, page(s) 9-5)

Key Elements

1. Maximum Performance
2. 1st 90° - Constant Bank, Changing Pitch
3. 2nd 90° - Constant Pitch, Changing Bank
4. Coordination

Elements

1. The Science Behind It
2. Performing the Steep Turn

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 can perform a smooth, well-coordinated chandelle without the instructor's guidance. The student should also understand the factors influencing control and coordination throughout the maneuver.

Instructor Notes

Attention

The Chandelle is a Maximum Performance climbing 180° turn. We're going to get the airplane to climb as much as we possibly can, going from 95 knots down to just above the stalling speed.

Overview

Review Objectives and Elements/Key ideas

What

A chandelle is a maximum performance climbing turn beginning from approximately straight and level flight, and ending at the completion of a precise 180° turn in a wings level, nose high attitude at the minimum controllable airspeed. The airplane should gain the most altitude possible for a given degree of bank and power setting without stalling.

Why

This maneuver greatly develops the pilot's coordination, orientation, planning, and accuracy of control during maximum performance flight.

Lesson Details

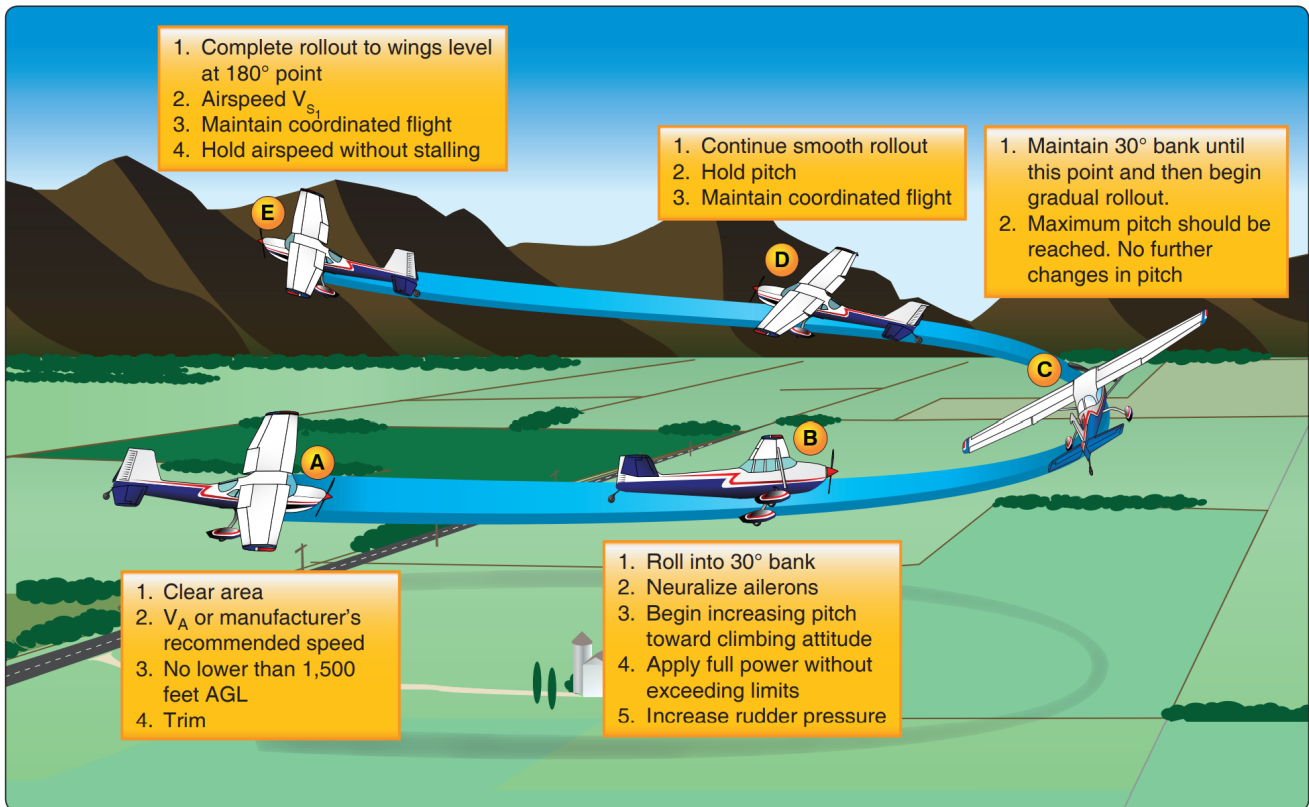


Figure 9-3. Chandelle.

1. First select a starting altitude.
 - a. This altitude should be no lower than 1,500 feet AGL, and should be an altitude that is easy to read on the altimeter (nearest 500 foot increment is a good choice).
2. Perform the pre-maneuver checklist
 - a. Fuel Pump - ON
 - b. Mixture - RICH
 - c. Gauges - GREEN
3. Ensure that the area is clear of traffic
 - a. While it is good to clear above, below, and at the starting altitude, clearing above is most critical due to the fact that this is a climbing maneuver.
4. Flaps and gear (if retractable) should be in the UP position.
5. The aircraft should be in straight-and-level flight at about 89-110(PA28A) knots.
6. Note the airplane's heading, understanding that the rollout will be on the reciprocal heading.
7. Choose a visual reference point 90° off the wing in the direction in which the turn will be made.

First 90° of the Turn

TLDR; Constant Bank, Changing Pitch

1. Smoothly enter a coordinated 30° turn
 - a. This turn will normally not exceed 30° of bank, and once the bank is established it should

remain constant until the 90° point. Pitch attitude will be approximately 12° as 15° reaches stall speed too early and 10° doesn't quite get there.

2. Apply full power as the pitch up begins (not before), so that airspeed does not increase prematurely but so that full power is used for the climb.
3. Airspeed should be approximately at the midpoint between the entry airspeed and the minimum controllable airspeed of the aircraft.
4. Keep the aircraft coordinated at all times.
 - a. As the airspeed decreases through the turn the torque effect becomes more pronounced and must be countered. Right rudder will need to be gradually increased to maintain coordination. Note that in a left turn less right rudder will be needed, and in a right turn more.

The summary of the first 90° is that bank is held constant, pitch is increased at a constant rate to attain the highest pitch attitude at the 90° point, and increasing right rudder will be needed.

Second 90° of the Turn

TLDR; Constant Pitch, Changing Bank

1. At the 90° point begin rolling out the bank at a constant rate while maintaining a constant 12° pitch attitude.
 - a. Roll out roughly 10° of bank for every 30° of heading change.
2. As airspeed decreases increased back pressure will be needed to maintain a constant pitch attitude. Airspeed is approaching the stall speed so maintain back pressure to obtain maximum performance without stalling the aircraft.
3. Left turning tendencies due to P-factor and the slip stream become more pronounced demanding even more right rudder to coordinate the turn

The summary of the 2nd 90° of the turn is constant pitch, decreasing bank, and increasing rudder pressure.

The Rollout

1. Time the rollout so that wings are level at the 180° point.
2. The pitch attitude should be held momentarily while the airplane is at its minimum controllable airspeed.
3. Left Chandelle Rollout
 - a. The left wing must be raised by lowering the left aileron. This creates more drag on the left wing resulting in a tendency for the airplane to yaw to the left. With the low airspeed torque effect also tries to make the airplane yaw to the left. To maintain coordination significant right rudder will be required.
4. Right Chandelle Rollout
 - a. The right wing must be raised by lowering the right aileron. This creates more drag on the

right wing and tends to make the airplane yaw right. At the same time the effect of torque at the lower airspeed is causing the airplane's nose to yaw to the left. These two forces work against each other causing there to be somewhat less need for right rudder.

5. The rollout is accomplished by applying aileron pressure, and gradually reducing the rudder pressure, with left rudder being applied only if needed to maintain coordination.
6. In either the right or left chandelle rollout, when the wings are level the aileron drag is neutralized and the torque is then acting alone.

Finishing the Maneuver

1. Gradually reduce the pitch attitude to resume level flight attitude.
2. Allow the airplane to accelerate while maintaining a constant altitude.
 - a. Right rudder pressure during the pitch decrease must be increased to counteract the additional torque caused by gyroscopic precession of the propeller.
3. Adjust pitch, power, and trim for cruise flight.

Maneuver Notes

There are a number of factors which can cause a failure to achieve maximum performance during this maneuver. If the initial pitch (and therefore airspeed) is not established correctly at the start performance will be degraded. Too high of a pitch and the aircraft will stall prior to reaching max performance, while having the pitch too low and the climb performance will be degraded.

Similarly, maximum performance will be degraded if the bank is not established correctly. A constant 30° of bank, in the first 90° turn, is essential. Too much bank results in an early completion of the turn and less altitude gained. Too little bank results in the aircraft slowing excessively, or stalling, prior to completing the turn.

Maximum performance is also degraded if the power is not set to the maximum. Less power results in lower altitude gained. Always ensure that maximum power is being used. The pitch numbers cited in the steps above are approximate, and should be adjusted for your specific aircraft.

Finally, maximum performance is degraded if the aircraft is not coordinated through the entire maneuver. Uncoordinated flight results in additional drag, decreasing performance.

Common Errors

- Improper pitch, bank, and power coordination during entry or completion
- Uncoordinated use of flight controls
- Improper planning and timing of pitch and bank attitude changes
- Factors related to failure in achieving maximum performance
- A stall during the maneuver

Conclusion

The chandelle is a maximum performance climbing 180° turn. During the first half of the turn bank is held constant while pitch is constantly increased. Through the second half of the turn, pitch is held constant and bank is constantly decreased. Throughout the maneuver it is important to keep the airplane coordinated, especially as the speed of the airplane decreases.

ACS Requirements

CFI PTS Standard

To determine that the applicant

1. Exhibits instructional knowledge of the elements of chandelles by describing:
 - a. The purpose of chandelles and their relationship to basic/advanced airmanship skills.
 - b. Selection of entry altitude.
 - c. Entry airspeed and power setting.
 - d. Division of attention and planning.
 - e. Coordination of flight controls.
 - f. Pitch and bank attitudes at various points during the maneuver.
 - g. Proper correction for torque effect in right and left turns.
 - h. Achievement of maximum performance.
 - i. Completion procedure.
2. Exhibits instructional knowledge of common errors related to chandelles by describing:
 - a. Improper pitch, bank, and power coordination during entry or completion.
 - b. Uncoordinated use of flight controls.
 - c. Improper planning and timing of pitch and bank attitude changes.
 - d. Factors related to failure in achieving maximum performance.
 - e. A stall during the maneuver.
3. Demonstrates and simultaneously explains chandelles from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to chandelles.

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 above ground level (AGL).

3. Establish the appropriate entry configuration, power, and airspeed.
4. Establish the angle of bank at approximately 30°.
5. Simultaneously apply power and pitch to maintain a smooth, coordinated climbing turn, in either direction, to the 90° point, with a constant bank and continually decreasing airspeed.
6. Begin a coordinated constant rate rollout from the 90° point to the 180° point maintaining power and a constant pitch attitude.
7. Complete rollout at the 180° point, $\pm 10^\circ$ just above a stall airspeed, and maintaining that airspeed momentarily avoiding a stall.
8. Resume a straight-and-level flight with minimum loss of altitude.