The Secrets of the Chandelle

Ask four questions to point students in the right direction

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Commercial pilot maneuvers, namely the chandelle, lazy 8, and the eight-on-pylon, are possibly some of the most analyzed maneuvers an instructor pilot will teach a student. Yet for generations, instructors still give students verbatim knowledge directly from the *Flight Training Handbook* (and now the *Airplane Flying Handbook*). As a supervisory instructor, I find students have little understanding of the perils and pitfalls of commercial maneuvers during their stage-check evaluations.

Excellent instructors, who themselves have a firm understanding of commercial maneuvers, sometimes do not convey a specific maneuver's most important points. For example, though a multitude of complex variables can lead to poor student performance, chandelles have a few specific traps that aren't introduced during students' introduction to the maneuver. Ensuring students can answer basic questions about the maneuver can ease a number of difficulties in the training process.

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The chandelle has a basic form. The student holds a constant bank angle for 90 degrees of heading change while pitch increases, then holds a constant pitch angle for another 90 degrees of heading change while decreasing the bank angle. The instructor should stress proper coordination throughout the maneuver, and the student should apply full power as the initial turn is established at 30 degrees (more powerful aircraft may use lower power settings to keep the pitch angle reasonable).

It sounds easy, but some students don't quite master the maneuver outright. That's because the chandelle is more complex than it seems. More extensive knowledge allows your students to cut down on the practice time necessary.

Ask your students the following questions to see how well they know the chandelle:

1. How high should the pitch get? If they answered in degrees, you're setting a difficult precedent if the students attempt to fly another aircraft or the atmospheric conditions change. While a ballpark pitch angle is a good way to get students close to the answer, the real answer is this: whatever pitch angle you need to get the aircraft within 5 knots of the power-on stall speed at the 180-degree point, according to the commercial pilot Practical Test Standards (PTS). I've seen students who were 20 knots over stall speed but believed they'd done well because they accurately held a canned pitch angle.

2. What's the beginning power setting? Too often, I see students establish straight-and-level, allow the aircraft to stabilize its speed, set the power to a certain setting to perform a chandelle, such as 21 inches of manifold pressure (MP) and 2300 rpm, and then execute the maneuver, adding full power as they roll into the bank angle. It works splendidly, but when I immediately ask them to perform the maneuver again and they set the same cruise power setting to initiate the maneuver, it's a total flop. What happened? Poor energy management.

An aircraft always has three forms

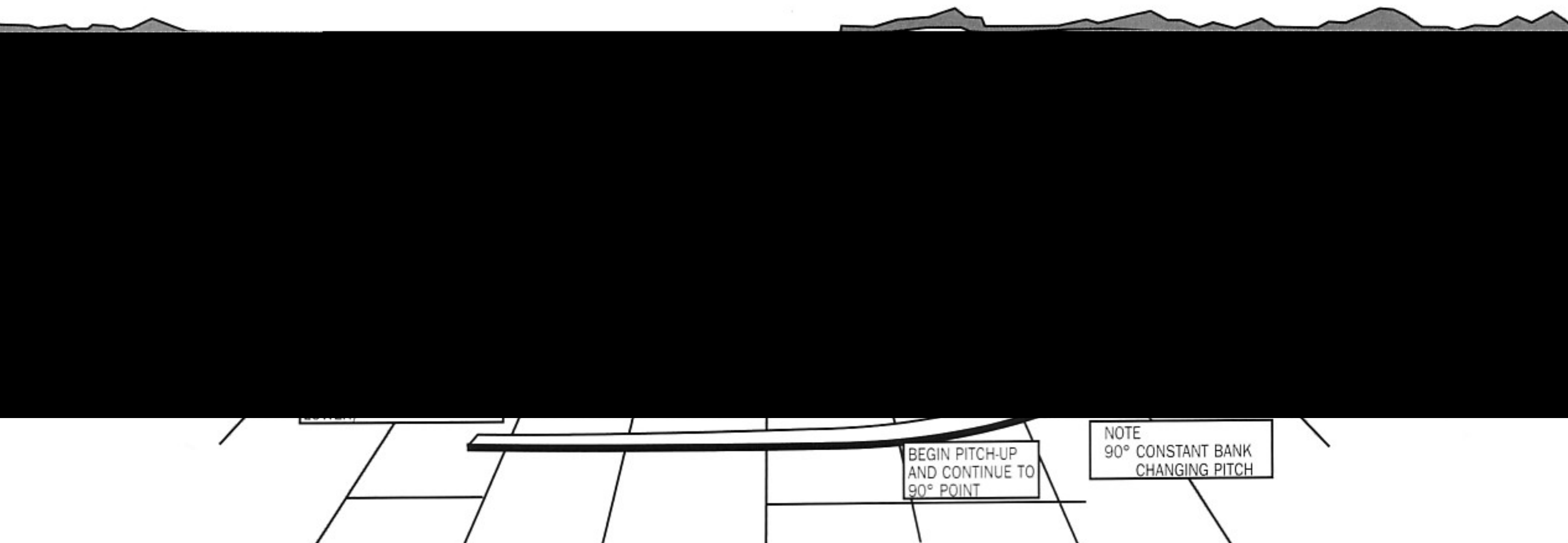
of energy available to it: chemical, in the form of burning fuel in the engine; potential, in the form of altitude; and kinetic, in the form of airspeed. At the conclusion of the chandelle, the sum of kinetic and chemical energy is constant—the maneuver ends at full power (or whatever power setting is used). If the student is using maximum chemical energy, airspeed should be within 5 knots of the power-on stall speed, and kinetic energy should be nearly the same each time. The amount of altitude you gain in the maneuver is essentially based on how much total energy was available at the start of the maneuver.

During the first execution of the chandelle, the student attained a cruise airspeed of 110 knots, which we'll assume is below V_A (design maneuvering speed), a requirement for the maneuver. The student executes the first chandelle, adding full power during the bank to 30 degrees. Upon completion, the student allows the aircraft to accelerate to 90 knots and then immediately executes the second chandelle after a momentary power reduction or by staying at full power. The student is starting with the same chemical energy but less kinetic energy.

If the student uses the same canned pitch angle, the speed will decrease past the target speed—possibly even past stall speed—or the student will need to lower the pitch angle during the second half of the maneuver, which isn't allowed. Memorizing a pitch angle for every entry airspeed is silly, so the solution is to begin the maneuver at the same airspeed every time. The student should use whatever power setting is necessary to achieve that airspeed. In the summer or at higher altitudes, this will require more power than in the winter or at lower altitudes, but in this manner the pitch angle will usually end up being the same. This also precludes problems with a hefty examiner.

3. How do you keep the inclinometer in the center? Unless your students are flying an aircraft with a counterclockwise rotating propeller, they'll need right rudder. In a right chandelle, they'll need a little rudder to initiate the turn and very little, if any, during the slow rollout. In the left chandelle, students will need a considerable amount to keep the aircraft coordinated during the rollout—the airplane's rolling out with right aileron, which creates adverse yaw that must be overcome with the rudder pedals. In the right chandelle, the adverse yaw and left-turning tendencies tend to cancel each other out.

4. How do the controls move during the constant pitch half of the maneuver? Constant pitch does not equal constant control force, but many students aren't aware of this. As the airspeed continues to go down, control effectiveness is reduced, so more back pressure is necessary to maintain a constant pitch angle. Students end up doing very well with the pitch during the first half, but pitch gradually decays during the second half.



CHANDELLE DIAGRAM

Make sure your students know they will need to gradually apply elevator pressure throughout the maneuver, not just during the first half.

Maintaining a constant bank angle during the first half also requires changing aileron pressures, as you might have guessed. As speed decays and control effectiveness is reduced, the amount of aileron used to negate the "over-banking tendency" becomes insufficient.

There is no substitute for practice. However, among students with similar experience levels, those who could answer these four questions properly typically demonstrated the best chandelles. Make sure students understand what's happening and why. Applying these concepts will help them solve the "mystery problems" that cause learning plateaus.