

# Teaching the Basic Aerobatic Course



## Part Three: The second lesson plan

*The following is the third part of a series about teaching a basic aerobatic course. The course is about teaching the four fundamental maneuvers of aerobatics (loops, rolls, hammerheads, and spins) to the beginning student. Here I will be addressing the instructor who wants to learn more about teaching this kind of course, but hopefully the contents will be helpful to those seeking to begin an aerobatic course as well.*

*Flight instructing is an art, and therefore it is personal. I will share my personal techniques and philosophy about the subject, but in the end each instructor will teach his or her students with a style best suited to them. Therefore, no information shared here is meant to be a judgment of the quality of the instruction given by anyone else.*

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In the last segment, we covered the first flight and what I would usually cover in the lesson. The emphasis was on getting the student familiar with the new aircraft, learning good orientation techniques, and doing the first aerobatic maneuver: the fundamental aileron roll. That lesson assumed the student had no aerobatic background or experience in the typical aerobatic aircraft, a clean canvas with which to paint a new picture.

Students often ask what would be the best reading to prepare for their course. I always tell them if they want to prepare, get a copy of *Stick and Rudder* and give it a good read. As for aerobatics, I want to be the first impression. There are many great works out there, and I personally approve of most, but each manual on aerobatics has its style and that is easily confusing. My preferred style is to explain each point in simple terms easy to relate to, and then after completing my course, I strongly encourage my students to dig into the technical side with any of many great books. By then they have been there, done that and can relate to the more complex explanations. By my way of thinking, it's a mistake to attempt to pack a huge amount of information into the student's head and then expect him to decipher it all in such a short course. Let's go by the old acronym KISS (keep it simple, stupid).

I start the second lesson by first assuring that lesson one has been successfully retained. We do a few of those really fundamental rolls as a warm-up and review. They usually need a little polish, so keep in mind that our primary purpose was to A) get the student used to a real aerobatic maneuver and B) teach the student how to "feel" when she is at the zero lift angle of attack. I use this time to re-emphasize how useful a simple roll like this can be when one accidentally ends up inverted.

The first new task of lesson two is to improve on the roll. It is all part of a sneaky plan. I don't teach slow rolls all at once. What I do is begin with the fundamental

aileron roll and slowly improve on it in a series of changes offered each lesson. The roll eventually is "straightened out" into a level-flight roll! On this flight I offer a new way to start the roll and a new way to end it. I leave the parabolic arc, in the middle of the maneuver, alone for a later lesson.

The new beginning is to combine the efforts of adding aileron deflection to the roll and setting the neutral or "zero lift" angle of attack (AOA) into one motion instead of the forward-then-left-stick "L" we learned the lesson before. To do this, I have the student first do the usual pitch-up to establish an arc (but this time not as steep), and then I have him apply aileron followed immediately with forward stick until the stick eventually ends up in that same full-aileron/zero G position. But this time the student is going to have to apply a short, but definite, coordinating rudder deflection to counter that brief period of adverse aileron yaw caused by applying ailerons before getting to the zero lift AOA. All this is accomplished in just a few degrees of roll, and once set, the aileron roll progresses as usual.

Once the student can execute the new start of the roll, show her the new way to end it. At the last knife-edge position, have the student begin "top rudder," meaning rudder in the direction of the roll to keep the nose up on the horizon. At the last 45 degrees of roll, have the student introduce elevator back-pressure to again

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hold the nose up. From there the student tapers off the rudder as the roll is completed. For review: top rudder, back-pressure, off the top rudder. With a little repetition, the student will pick up the finesse required to taper these control moves in and out. In the preflight briefing, use a model to

show how the controls needed to hold the nose up transfer from the rudder to the elevator during this ending. During practice, I always take the opportunity to point out how useful this ending is in reducing altitude loss when the roll is used as an upset recovery method.

The new maneuver for lesson two is the loop. This old barnstormer move is a lot of fun to do, fun to teach, and packs a wallop of benefits when it comes to busting the student out of his two-dimensional world. I start by explaining that the loop is akin to the motorcyclist at the circus that drives along a looped path. He has to enter



with enough speed to keep a positive G on the loop-shaped ramp; otherwise he would fall. We loop airplanes with a positive G on the wings. But with the ability to vary the size of our loop, we are charged with the task of creating a loop size and airspeed that will work.

We are also charged with the task of keeping our loop symmetrically round. When we learned turns-around-a-point as students, we had to correct for changing groundspeed by turning harder when we were downwind and slower when we were into the wind, so as to keep a round circle. Loops are not “groundspeed” maneuvers; they are “airspeed” maneuvers. But the analogy works in the sense that at high airspeeds, we have to pitch harder, and at low airspeeds, we pitch lighter to keep our loop round.

So here is how I explain it. After obtaining the recommended entry speed, we set the size of our loop by how hard we pull. I find most aircraft I fly can do a nice round loop with an entry G-load of about 3.5G. This has worked for me from Cubs to jets. There is surely some room here for personal technique, but my comfort level for a good loop falls between 3G and 4.5G. The beginning of the loop is a fast place in the loop, so this G comes along right

away. Smooth but immediate application is required. The top of the loop is obviously the slowest point and will require the minimum G for the maneuver. I find myself cresting the loop near, but not quite at, zero G. On the way up, use two checkpoints to determine if you are pulling correctly. Through the vertical you should be noticing a detectable need to relax the pull on the stick. Through the 45 degrees-on-your-back position you should be dropping below 1G or beginning to feel light in the seat.

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At the peak of the loop a subtle but definite change in stick motion is applied to go from “getting slower and light” to “getting faster and heavier.” The 45-degree nose-down position marks the beginning of significant airspeed acceleration and increasing back-pressure/

G-loads. The loop ends with the plane back to high speed and maximum G.

Your student will most certainly experience some of the common errors found in performing the pitch aspect of the loop. The first is at the entry, where most will add back-pressure too cautiously and slowly, causing the airplane to attempt too large a loop. This usually ends with the airplane poised straight up and running

out of airspeed. To get you and your student out of this predicament, be sure to cause it to upset so there is no tail slide. Just continuing to let the nose pitch over will usually do. Take this opportunity to show your student how, as the plane pitches over abruptly and has little airspeed to fly, you can neutralize the stick, reduce the power, and the airplane will seek out straight flight like a lawn dart. The contrast to this is a rushed pullout that encourages a spin.

The less likely error at the entry is to pull very hard with no letting up. This usually causes an accelerated stall at or near the inverted position. Correct this again by going to the lawn dart position first to stabilize and then roll to right side up. I always hope the student makes at least one of these mistakes so she can experience the correct way to recover.

I find the next pitching error is the student getting carried away with letting up back-pressure on top. This makes for a flat-top loop and sometimes causes a real “cone of confusion.” It can be confusing because as students let up too much, they sometimes cross into a negative angle of attack creating a negative center of pressure on the wing or, simply, a negative weight and balance. This makes the stick go very light when the instructor is in the back of a Decathlon or Citabria and can lead the student astray! Tell students that if the scenery out the front windshield begins to get very slow or quits changing altogether, they need to PULL!



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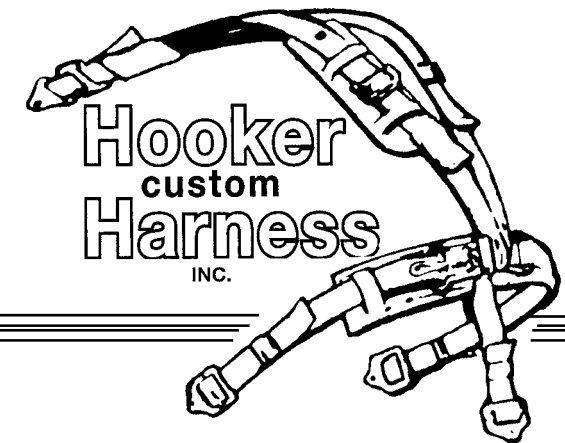
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Next, we need to back up and discuss the visual orientation for the loop. As the loop is entered, have your students look straight ahead to check for the airplane being square with the horizon, not trying to bank or yaw. As the nose cuts the horizon, have them move their eyes to the left wingtip to see the plane of the wing and the horizon all at once. There they will see their pitch checkpoints. The wing should appear to twist as it stays right on the horizon (or relatively stable in position as it twists). As the airplane reaches the top of the loop, have them turn their heads straight ahead and catch the horizon (and the straight reference you are flying over) and follow the reference on around the loop. The most common error in reference is students not turning their head. We learn early on to reference our attitude by looking at the nose of the airplane, and it is difficult to wean some students of this habit. Watch closely for this, and remind them every loop if required.

Finally, let's go over the use of rudder in the loop. On that initial pull, you will be introducing a big gulp of P-factor. You will also be causing some gyroscopic precession. P-Factor draws you left and gyroscopics draws you right. The P-factor wins in everything I have ever flown except when flying behind one of those M14P radials. But, since they turn backward, you still

need right rudder! So as the loop starts, anticipate the need for right rudder. You will see its handiwork while you are watching the wingtip. Normally the tip creeps down during the loop indicating the lack of correcting rudder. Remember, when watching the wing on the pull-up, you can raise it with the right rudder and lower it with the left rudder.

The need to correct for P-factor will decrease as you back off the elevator going over the top. But, just to keep you on your toes, a new requirement for right rudder creeps in as you are getting slow. Spiraling slipstream (air swirling around the fuselage from the prop) will begin to give the airframe a mild left twist, so a little right rudder has to return to fix it. You can teach your students to see this by noticing the wingtip trying to slip back from whatever point it is presently on. The truth is, this is a bit much for most students to notice on their first go at loops, but tell them all about it so they at least understand why, when they turn their heads

to look straight ahead at the top of the loop, the nose is always a little off to the left!

By this point in the lesson, you have the student finessing his way through better aileron rolls and doing loops that start and end in the same direction, and maybe kind of close to entry altitude. It's too early in his

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aerobatic career to get too picky, so be sure that while showing him what's wrong, you're encouraging him with comments on what went right! For heaven's sake, by this point you have both been working hard, so take a moment to check the fun meter here.

If things are going well I like to have my students do a whole bunch of loops and rolls in combination. It makes them speed up their thinking and gives you a chance to introduce a good habit of establishing level flight between maneuvers. Those early habits last the longest. Your student will soon learn the importance (and maybe the consequences) of how they set up for each maneuver.

I use the skills learned so far for one last exercise before heading home. I have the student do a loop, but at the tiptop, I have her do the last half of an aileron roll (be sure to let her know this is not the true definition of an Immelmann or a Cuban). I call it a roll off the top of a loop. This does a couple of good things. First, she learns how to do a roll to level from a less than ideal speed. That's great for preparing her for an unexpected upset/recovery. Second, it builds on her ability to find her orientation. I still remember how confusing all this flip-flopping is in the beginning!

The second lesson is surely a busy one, and the third one really gets going! If doing only two maneuvers doesn't sound busy consider this: As great and wonderful pilots who love what we're doing, we easily slip into a common pilot and instructor error—we all want to get to the cool stuff in a hurry! But as good flight instructors, we should direct our students through some good ol' repetition. Practice, practice, practice. Time spent in supervised practice is giving them the quality instruction they're paying the big bucks for. It can surely be a lot less exciting for the instructor, but believe me, your students are up to their earlobes in excitement.

Lesson three adds the third of the fundamental maneuvers: the hammerhead. Until next time, please feel free to contact me with any questions at [greg@gkairshows.com](mailto:greg@gkairshows.com). Your questions are welcome, and believe me, if you have a teaching technique you are willing to share, I'm willing to learn. 🇺🇸



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