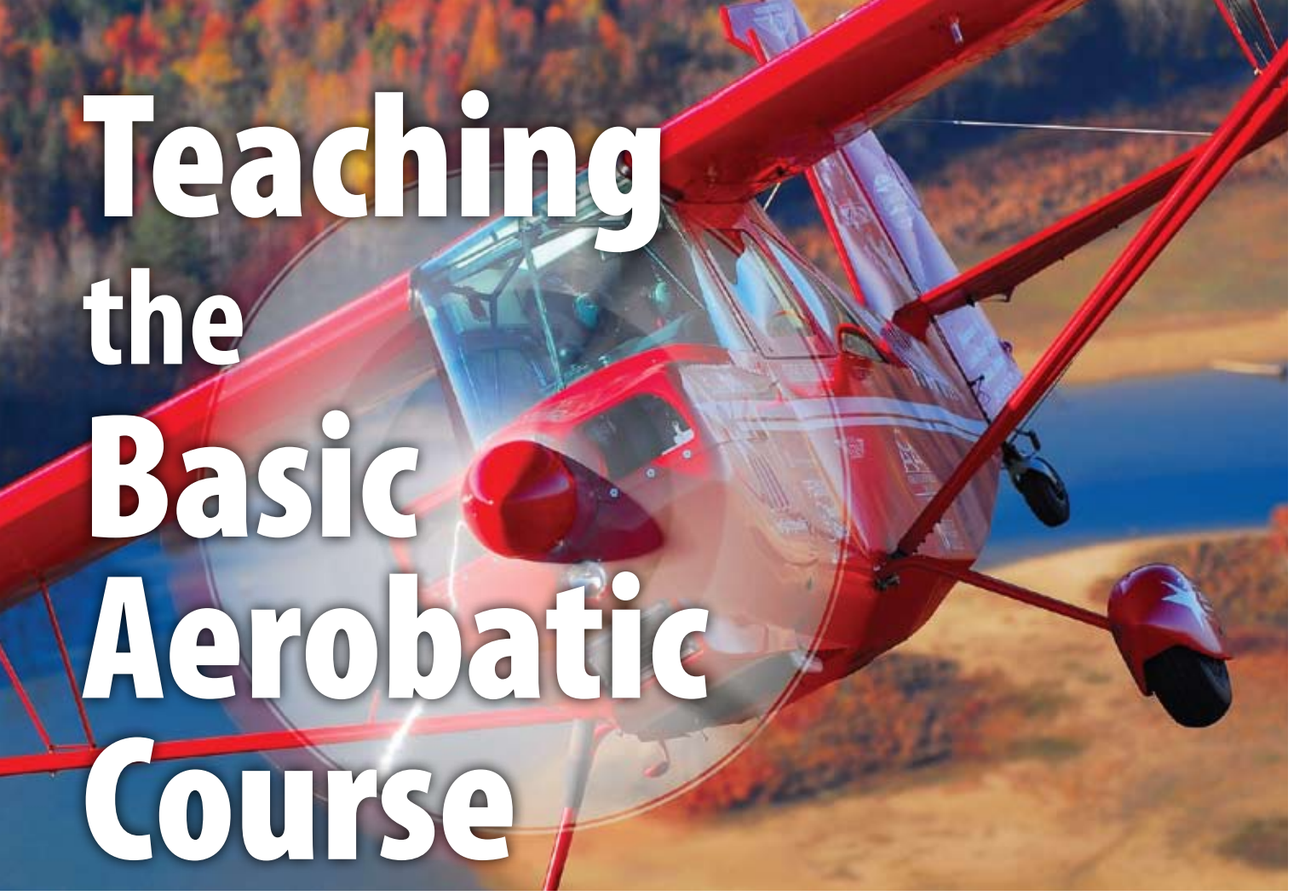

Teaching the Basic Aerobatic Course

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Part Four: The third lesson plan

The following is the fourth part in a series about teaching a basic aerobatic course. The course teaches the four fundamental maneuvers of aerobatics (loops, rolls, hammerheads, and spins) to the beginning student. 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.

Your student has returned once again and is ready to venture into lesson three of the basic aerobatic course. Good for you. You didn't overwhelm him, make him too sick, or scare him away. Lesson two must have been a complete success.

Lesson three is a serious review of loops, rolls, and combinations thereof. The new maneuver for the flight is the hammerhead. But before we jump into the new maneuver, let's take a good look at where our student is right now.

Typically, this lesson presents the first big hurdle for the aerobatic student. In the first lesson, you taught her the relationship between aileron drag and angle of attack. This is more confusing for the average student than you might think. Concepts that involve thin air and flying machines are pretty foreign to the average ground creature and require some time to absorb. By now you have the student doing some pretty good aileron rolls. Hopefully you spent some time pointing out the effects of aileron drag when the maneuver was attempted, without being at the zero-lift angle of attack (AOA) (more commonly called "unloading the wing"). Seeing it in action helps the student understand it. The truth is most of us will attempt to learn by memorizing the steps of a maneuver and not by completely understanding it. It helps us handle the complexity, and we can figure out the details later.

So your student might be doing some of the things you taught him mechanically. It's okay. In fact, you should expect it to happen. But as you add more information and expect an understanding of what you've done so far, you are going to find a limit to how much he can perform mechanically. This is where you are going to find your first learning curve, and it is typical of lesson three.

It reminds me of calculus. I did fair in algebra and sneaked by in trigonometry. I memorized enough not to fail. But when I took calculus, the weak bridge I stood upon collapsed. You can expect to find many students doing the same with lesson three. To avoid disaster in most cases, be sure to ask students to explain why there is no aileron drag at zero-lift AOA and–most importantly–why we are so concerned about that AOA when doing the aileron roll. If they can't tell you, it's time for a thorough review. While doing so, reinforce the concepts and the advantages of the new entry and exit from the roll you showed them in lesson two.

Now you have a decision to make to set the direction you will go from here. If a review of all you've done so far seems to be well within your student's abilities, you might be ready to make the middle of that aileron roll look more like a level slow roll instead of an arc. If this is the case, let's go over your next change to the roll before we talk about hammerheads.

In the last lesson, you showed the student how to blend the aileron and elevator inputs to enter the roll, and you showed her how to use top rudder and then back pressure to end the roll flatter: two steps toward an eventual slow roll. Now let's flatten out that middle arc to have at least a rudimentary slow roll developing.

First, tell her you are not going to set the arc by lifting the nose up before the roll starts, like before (lifting the nose a little for the first attempts might be necessary if the student is having trouble). As the roll starts and the usual forward elevator is applied, have her push a bit further this time to compensate for not having raised the nose. Your earlier explanation of aileron drag will make sense here. Show her the need for right rudder in a left roll to compensate for negative aileron drag, and for top rudder in the first of the roll to hold up the nose. Show her how to taper off the right rudder as she passes through inverted, and then, using the top rudder technique learned in the last lesson, she can bring the roll on around from there. This is essentially step three in my four-step process to teach slow rolls.

I know what you're thinking right now: "Hey, there's a little more to it than that." You are right. I have learned that the slow roll is the most complex and, for their experience, the most difficult maneuver your students are going to attempt for a long while. I found out years ago that I could direct a student to a great slow roll if I chip at it a little at a time. After your student is comfortable doing this version of the roll, she will be ready to clean up the loose ends and smooth it out in step four. That is most likely going to be during lessons beyond this course.

In flight, your third lesson begins with loops and rolls. If you have chosen to progress the slow roll with a student, I suggest making that your first order of business following a short review of the simpler version of the roll as a warm-up. If you have decided that the roll is best left alone for now, use the time to practice the technique learned so far. Again, be sure you let him see all the effects of adverse aileron drag and how unloading the wing changes it.

Time should also be spent fine-tuning the loop. Most students have trouble with the need for right rudder on the initial pull (for P-factor) and even more difficulty seeing the need for right rudder over the top (spiraling

Greg Koontz discusses the finer points of the aileron roll with his student.

slipstream). While you were probably more concerned with where the student was looking and how he was pulling on the last lesson, you can probably spend some time this lesson emphasizing the propeller forces. Like for everything else, it's a building block method of learning, one block at a time.

By starting rolls in lesson one and loops in lesson two, you get four shots in this course at improving the roll, and three at improving the loop. This is right in line with their order of importance and value to the student's development. Now it's time for hammerheads. You have just this and the last lesson to cover them, and I have to tell you, they can present some challenges to the student to learn and the instructor to teach.

Hammerheads are my favorite. That long vertical line, the feeling of almost stopping the airplane on top, and that rush you get pointing straight down as you accelerate all make this maneuver what aerobatics is all about! But the anxiety of doing this maneuver can make your student have a different opinion altogether.

If your student is being too timid to load the plane with the necessary G's, is too reluctant to hold the stick forward during a roll, and tends to get abrupt or erratic on the controls, then he might need more time to settle down before moving on to hammerheads. Most people will show at least some of these symptoms by this lesson. It's a part of the learning process. You should be able to get hammers done here with most students. You'll find most students relax a great deal on this lesson after a successful review of loops and rolls.

I explain the hammerhead in three pieces: the vertical line, the pivot, and the vertical descent. As with all my explanations, I try to develop an understanding of how one should think of this maneuver and leave heavy details for good reading later. As I said once before, we don't fly with a slide rule in our hands, but we should eventually learn all we can.

To warm up for this maneuver, have your student run through a few of those "crazy-eights" from the first lesson. Only this time, do all of them to the left and tell your student that the objective will be to always keep the wings parallel to the road. She will pull up, add rudder to arc over, and find she needs opposite aileron to keep the wings parallel. Great stuff! This technique has drastically shortened how long it takes me to teach a hammerhead. After a few "crazy-eights," all that's left is to straighten it up into a formal hammerhead.

THE VERTICAL LINE: The pull into the hammerhead is not unlike doing the first one-fourth of the loop. In competition, we like a tight corner here to draw the maximum vertical line. For the beginner, be merciful and be happy with the familiar pull we have used for the loop. Once pulling the first 90 degrees of pitch, the first task is to stop on the vertical. The student has the objective of stopping the pitch by moving the stick to the zero-lift angle of attack with the wing on the vertical. Here you are to reinforce the require-

Instead of sitting out on the porch enjoying the view of his airfield, Greg Koontz brushes up with *Sport Aerobatics*.

ment to look at the left wingtip, just like in the loop. The student gets a nice long look at this position and can better learn what needs to be done with the rudders to keep the wing on the horizon. It's "**L**ower the wing with the **L**eft rudder and **R**aise the wing with the **R**ight rudder."

The vertical line requires maintenance. That is, you can't "set it and forget it." The student is pushing against the trim setting for level flight, and the speed is rapidly fading. This requires constant maintenance of the pitch as well as the yaw and roll; all are being affected by trim and propeller forces. The most common error here is letting the airplane drift over on its back, and the second is dragging a wing. Fixing a dragging wing is relatively easy, but correcting a plane that's a little on its back requires forward stick. This is a potential problem if done late. Your student can be setting control inputs for an inverted spin. I find basic trainers like the Super Decathlon are pretty forgiving here, so don't instill too much fear in explaining this. Just make your student aware of the error.

"THE PLANE IS GOING TO ACT JUST LIKE A CANNON BALL GOING VERTICAL."

The airplane *must* be vertical when arriving at the top for the pivot. A little negative or positive will send the plane in a slanted track that will not work. Just as adverse, the wings must be square, with yaw in check. Wile E. Coyote can run off a cliff and run back in a cartoon, but we mere mortals can't pull that off. The plane is going to act just like a cannon ball going vertical. If it is not straight up, it will enter an arc that will totally destroy your ability to pivot correctly at the top.

THE PIVOT: With only a trace of vertical velocity, apply firm left rudder (the pivot works best to the left due to the propeller forces). You are looking to fly a micro arc here in most trainers, so just a little motion is necessary to start. Begin by helping your student find the place to pivot and then eventually back off and make her decide. Just prior to reaching the vertical down attitude, arrest the pivot motion with a short application of opposing (right) rudder. This brings the airplane to a vertical position ready for the downline.

But wait! The pivot can't be that easy! Well, it isn't. We've got to handle some propeller forces here, too. As you begin your left rudder to pivot, you'll need to apply right aileron for torque (just ask air show performer Skip Stewart with his big-motored biplane) and forward stick to control a big gulp of gyroscopic precession. It amounts to a push of the stick to the right front "corner." If you choose not to reduce power, expect to begin backing off this correction at about the last 45 degrees of pivot as the plane tries to accelerate and widens the arc.

Your reference for all of this pivoting is the left wingtip. I do these first hammers across a reference like a straight road and then move later to doing them along the reference. As the student pivots, her eyes should follow the wing along the reference until the wing reaches the point under the plane for the vertical. There, they should lock on the spot and head for it. Early on, a quick look at the wingtips can confirm the vertical

Teaching aerobatics is about gradual reinforcement and having fun!

downline. I find students learn what it looks like soon and can stop the wingtip look for a more stable concentration on the reference.

THE DOWNLINE: You're not finished yet! The biggest training error in this maneuver is rushing out of the vertical downline. Be sure to draw the line equal to the vertical upline. For the still timid student, this might be a place for a little anxiety. But for most it's just impatience. Set the correct habits early and make sure students do the line.

So what are the real pitfalls here? Well, there's a lot going on and the hammerhead has little forgiveness. You're going straight up and the plane isn't going to wait for you to make up your mind! The biggest problem is a tailslide out of a late pivot attempt. Waiting too long will leave you short of energy and control. The Super Decathlon isn't approved for tailslides like most trainers, but don't panic. If you run out of "umph" before you accomplish the pivot, simply keep trying to pivot. If nothing is happening, I find a lot of success in pulling myself over on my back. In any event, trying to upset the plane will result in an early reversal of direction instead of much tailsliding. As soon as you flop over, reduce power, neutralize the controls, get a little speed, and pull out of the dive like a loop.

So now you've refined the roll, practiced the loop, and introduced the hammerhead. The lesson is just about done. If time permits and your student isn't worn out, take a few minutes and have some fun. Put the three maneuvers in sequence and make your student do some fast thinking, moving from one maneuver to the other. Mix it up some. Don't forget to establish a good habit of drawing that straight and level line between each maneuver. And, finally, laugh a little, hoot and holler a little, and be sure to tell your student what was good about the flight.

Greg Koontz is a NAFI Master Certificated Flight Instructor-Aerobatic and has been teaching basic aerobatic courses since 1974. He is a full-time aerobatic professional sponsored by American Champion Aircraft flying shows in his Super Decathlon, is an aerobatic competency evaluator (ACE), and is a member of the International Council of Air Shows' ACE Committee. Greg is a member of the National Association of Flight Instructors (NAFI) and actively supports its efforts to raise the standards for aerobatic instructors.