

Unlike one-turn spins, where we must begin the recovery before reaching the intended exit heading, aileron rolls stop instantly when we neutralize the roll inputs. Be patient.



Recreational Aerobatics

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MASTERING THE AILERON ROLL

Aileron roll, slow roll, snap roll, barrel roll—maneuvers that incorporate the word “roll” into their very names. But the aileron roll and the slow roll are true rolls in the sense that aileron is indeed the primary input. The snap roll, on the other hand, isn’t a roll at all. The Aresti figure incorporates a spin-like triangle; more precisely, the symbol represents an accelerated stall/spin. And back when the barrel roll was part of the Sportsman category lexicon, its symbol depicted a roll with a tiny loop dangling like an earring from the arrowhead. Yet the barrel roll isn’t really a roll either; elevator is the primary input. The essence of this maneuver is a crooked loop, and one could argue that “barrel loop” is a more apt description of the intended maneuver.

Although the words “aileron roll” together are redundant, the phrase is used to differentiate the method of entry from the slow roll. A distinct pitch up characterizes the start of the aileron roll. By comparison, cross-controlled aileron and rudder inputs characterize the start of the slow roll. We also tend to speak casually about rolling with the nose of the airplane “on” a point. The fact is that the nose will always roll “around” a central reference point. In his book *Flight Unlimited*, Eric Müller writes mystically about sacred points that lie on the sacred circles tracked by the nose during perfect slow rolls. Aileron rolls have key points, too. And the shape carved by the nose is akin to the block letter “D” during a right aileron roll, and a backward “D” during a left aileron roll.

Slow rolls are used in aerobatic competition and in the Achievement Awards program. For the remainder of this article, though, we’ll detail the aileron roll. It’s the easier of the two rolls to learn. It’s essentially a 1g maneuver throughout, and when flown well it feels better than the slow roll. It’s also an ideal choice for the recreational aerobatic pilot. Our featured airplane is a 1978 Standard Decathlon (150 hp, fixed-pitch propeller).

As the name implies, our attention must be on the ailerons during the aileron roll. All other control movements are subordinate not only in terms of our focus, but also in terms of the magnitude of their displacement. It’s even possible to perform the roll with aileron deflection alone, but the maneuver would end in a steeply nose-down attitude, off the original heading, and with considerably more altitude lost than necessary. The intent of any rudder and elevator inputs during the aileron roll, therefore, is simply to improve the quality of the maneuver. Properly timed adjustments in rudder and elevator can be used to minimize deviations in our starting heading and altitude. From this standpoint, rudder and elevator movements serve a purely cosmetic function during the roll.

ROLL MECHANICS

We’ll break down our aileron roll into four parts: the setup, entry, roll, and exit.

PART 1: SETUP

Excursions from the starting altitude and airspeed are innate in the aileron roll. Rpm will change as well in our fixed-pitch Decathlon. Consequently, let’s trim for level flight at 2300 rpm. This power setting is a few hundred rpm below the marked red line on the Decathlon’s tachometer, so unless we fall out of the maneuver or end up significantly nose-low when we’re done, we shouldn’t need to adjust the throttle during the roll. Perform the obligatory clearing turns and point the nose toward a prominent reference. Push for 120 mph. Use small rudder inputs to maintain your heading during the shallow dive. Once you attain the roll entry speed, pitch to level flight. Pause for a beat.

PART 2: ENTRY

Pitch the nose up 20 to 30 degrees above the horizon. Don’t be shy here. Pull as though you’re performing a steep turn and load the airplane with 2 to 2.5g. Fewer g’s than this will result in too much speed being dissipated in the transition to the roll attitude; more g’s than this are unnecessary. Pull to the recommended nose-up attitude. Stop! Glue the nose to an imaginary point in the sky for a beat.

PART 3A: LEFT ROLL

Smoothly but smartly drive in full left aileron. Don’t let anything stop

you from reaching the control limit. This may require pressing your leg against the side of the cockpit to allow additional deflection. No matter what else happens from this point on, strive to apply more and more aileron as the roll proceeds, even if you believe you already have full deflection.

Simultaneously squeeze in a bit of left rudder as you drive in the left aileron. The purpose is to cancel the adverse yaw associated with our large and rapid aileron input. Insufficient left rudder here will cause the nose to yaw right, retarding the roll rate; excessive rudder, on the other hand, will slice the nose downward prematurely, resulting in a faster rate of altitude loss. Once applied, keep the relatively small rudder input where it is for now.

The airplane starts rolling the instant we move the stick laterally. By the time the ailerons are pinned against the control stops, we are well on our way to inverted in the Decathlon. Applying a small amount of forward elevator as the airplane nears inverted will reduce the rate at which the nose collapses toward the horizon. We’re not trying to prevent the nose from falling here; we just want to slow it down a little. So as soon as the ailerons are fully deflected, ease in a touch of forward elevator. Think of the aileron-elevator control movements as though you



Pitching up 20 - 30 degrees prior to entering the aileron roll is critical to a successful maneuver.



Above Maintaining full aileron deflection during the roll takes some practice.

Right The view as the airplane nears the first 90 degrees of rotation during a left aileron roll.



are shifting into gear in a car with manual transmission. Move the shift lever all the way over, then forward into gear.

The push during the roll, however, should be soft. Use mostly your wrist to displace the elevator rather than involving your whole arm. And although the stick only travels forward an inch or two, aim that push toward your kneecap. The ailerons must remain in contact against the control stops throughout. Release the soft push as soon as you see the airplane pass through the inverted position. "Release" is the operative word; do not pull back on the stick in the literal sense. Simply stop pushing forward.

The roll should now be within 90 degrees of wings-level flight. You'll certainly see the nose falling below the horizon here—this is perfectly normal! Accept the nose-low attitude. Resist the urge to try to pull the nose "up," as this invariably leads to two problems: First, you'll instinctively release the aileron input as you pull, thereby slowing the roll or even stopping it in a bank. Second, you'll pull the nose off the original heading. Keep that stick firmly against your left leg no matter what.

Instead, let's feed in additional left rudder as we advance toward upright flight. More left rudder applied during the last quarter of a left roll—especially the last 45 degrees of roll—offers several advantages:

Left rudder is now in the "top rudder" position and can be used to prevent the nose from dropping any farther below the horizon;

The supplementary left rudder cancels adverse yaw, which has increased somewhat since we first started the maneuver;

Our heading will be preserved.

Smoothly but continuously depress

the left rudder pedal until reaching wings-level flight. The more rudder you can feed in by the time you return to upright flight, the better. Provided the ailerons remain fully deflected as you stretch your leg out on the rudder pedal, you should sense a slight increase in the roll rate. The roll rate petering out, or stopping altogether, is a sure sign that you're releasing the aileron (and probably pulling aft on the stick) as the rudder is being applied. If you sense this, nudge the stick forward a tad and reapply the aileron. Maintain the aileron and rudder inputs until the wings are exactly level before neutralizing the controls.

PART 3B: RIGHT ROLL

The right aileron roll calls for the mirror image of the inputs applied during the left roll—right aileron and right rudder throughout. But with other things being equal, the right roll will tend to proceed at a slower roll rate for two reasons: First, the airplane is rolling against the engine effects in the Decathlon. Second, the biomechanics involved with the application of full right aileron (right hand on the stick) result in a rather awkward arm movement compared to a left aileron input. Be more patient and more persistent with all of your inputs when rolling right. If necessary, use two hands on the stick when applying right aileron.

PART 4: EXIT

Unlike one-turn spins where we must begin the recovery before reaching the intended exit heading, aileron rolls stop instantly when we neutralize the roll inputs. Be patient. Hold the aileron and rudder until the last possible second, even though the nose might be well below the horizon. We must complete the roll

in its entirety before worrying about the pitch attitude. Simultaneously neutralize the aileron and the rudder upon reaching wings-level flight.

Pause for a beat, then return the nose to a level flight attitude if need be. Pitch to level with the same pull used in the entry to the roll. Now verify that your heading is still the same as when you started. If the roll went well, including appropriate rudder and elevator corrections, your exit altitude should be close to your starting altitude, too. The *g*-meter should register +0.5 as the minimum and +2.5 as the maximum *g*'s encountered. The heavier *g* comes during the entry and exit pulls; the lighter *g* during the soft push applied once the ailerons are fully deflected.

The nose of the airplane follows a curve during the roll itself; the stick, however, moves in straight lines separated by right angles in our Decathlon. Changes in elevator and aileron are distinctly separate from one another, with inputs occurring along only one control axis at a time. Control movements have a definite rhythm to them as well. All the while, we're actively looking straight ahead at a reference point around which the nose is rolling.

SOME COMMON TENDENCIES

Problems pilots might have when performing the aileron roll include:

1. Pitching the nose up too slowly and not high enough prior to starting the roll. Pull as if performing a steep turn, and raise that nose a healthy 20-30 degrees above the horizon.

2. Beginning the roll before completely releasing the aft elevator used during the entry pitch up. Pull the nose up, freeze it there for a second, then apply full aileron.

3. Slow, hesitant, or incomplete application of full aileron. When it's time to roll, accelerate that stick from the neutral spot to full aileron deflection in one smooth-but-rapid movement.

4. Applying the forward elevator too late and too vigorously. The push on the elevator should be soft and applied almost immediately upon achieving full aileron deflection. It's better not to nudge the elevator forward at all than to overdo it. Think of the elevator and rudder actions during the roll merely as "adjustments;" hence, apply them subtly and smoothly. If you feel yourself shift in your seat as a result of a corrective action, chances are the input was too aggressive.

5. Pulling aft on the stick in lieu of, or while feeding in, additional rudder in the last part of the roll. Resist the urge to pull near the end of the roll. Focus on aileron and rudder only until wings-level flight. Finishing off heading to the right following a left roll, or off heading to the left following a right roll, are symptoms of pulling near the end of the maneuver.

6. Stopping the roll 10-20 degrees too early. If you find yourself consistently under-rolling, mentally tell yourself to perform a 370-degree roll.

7. If anything should go wrong during the roll, apply more aileron! Keep rolling until you are upright once again. Address the pitch attitude after the wings are level. Moreover, if the nose falls 30 degrees or more below the horizon, or if the ambient engine noise rises noticeably, reduce the power.

WORDS OF CAUTION

Please don't even think of rolling an airplane unless all of the following are satisfied: You've received dual

Rolling maneuvers tend to be the most common trigger for motion sickness in the majority of pilots (especially on days with a poorly defined horizon).

instruction in the maneuver first, you are proficient with the maneuver, it's approved in the particular airplane, you are operating within the aerobatic category envelope, and you have plenty of altitude in the appropriate airspace. Furthermore, FAR 91.307 stipulates that no pilot carrying a passenger may execute an intentional maneuver that exceeds 60 degrees of bank relative to the horizon unless all occupants are wearing approved parachutes.

Rolling maneuver tend to be the most common trigger for motion sickness in the majority of pilots (especially on days with a poorly defined horizon). Be

sure to focus your vision outside of the cockpit during your rolls. Take it easy on passengers as well by limiting the number of rolls you'll do to them. Either that or carry lots of airsick bags — but rest assured, making your passengers uncomfortable is no way to endear them to the magic of aerobatics (or to keep your cockpit clean and smelling fresh).

No matter how good a stick you think you are, performing an unapproved maneuver outside of the aerobatic category places you at higher risk should you botch the attempt. For instance, the

structural limits are -1.52 to +3.8g with the flaps up in the normal category, compared to -5.0 to +6.0g in our featured Decathlon's aerobatic envelope. Attempting to roll the wrong airplane at low altitude similarly has a slim margin for error and can be a recipe for disaster. Let's fly smart out there. ☺

The basic loop in an RV-7 is up next.

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