

# A Roll is a Roll is a Roll . . .

# Or is it?



*"If done right the aileron roll is smooth and gentle, but it can get out of hand fast, and non-aerobatic aircraft can't handle the stress of the recovery."*

Gordon K. Penner,  
MCFI-Aerobatic, FAA Gold Seal Instructor

Words are supposed to mean something, but some words have less specific meanings than others. They pick up regional differences, or they are part of a shorthand or slang. Words with multiple meanings cause the receiver to think one thing was meant when the sender meant something very different. Two terms in aerobatics that have multiple meanings depending on who hears them are "roll" and "aileron roll." Many of you would be surprised to learn there are different definitions of an aileron roll out there. So what kind of roll was *really* meant?

Actually, in the aerobatic world there are four different kinds of rolls. Each one is flown quite differently from the others. One of the four is the aileron roll. There are also at least two different kinds of aileron rolls. On top of that, what the Aresti (aerobatic notation) system calls an aileron roll is actually the slow roll (see below). Then we add to the above confusion by adding the term point rolls to the mix, which are just 2, 4, 8, or 16 equal hesitations while doing number 1, 3, or 4 below. Confusing? Let's unpack this problem, shall we?

The four different kinds of rolls are:

- 1. Barrel Roll (not a competition figure)
- 2. Snap Roll (competition figure)
- 3. Slow Roll (competition figure)
- 4. Aileron Roll (Bob Hoover roll—not a competition figure)

The two rolls we will be talking about in this article are numbers 3 and 4, the slow roll and the aileron roll. The barrel roll is actually like a loop where the pilot also completes 360 degrees of roll while the loop is being accomplished. Think of it as a loop that is pulled off to the side after it is started. Before the barrel roll

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begins the pilot picks a point on the horizon 45, 60, or 90 degrees off to the side of the nose of the aircraft. When halfway through the loop of the barrel roll, level fuselage and inverted, the aircraft nose should be pointing at that point. The pilot pulls more than 1G in the first third and last third of the “loop” (usually between 3 to 5Gs, depending on the airplane) and floats over the top at something less than 1G. The snap roll is more like a spin, where an autorotation is performed while maintaining a flight path. These two rolls will be covered in another article.

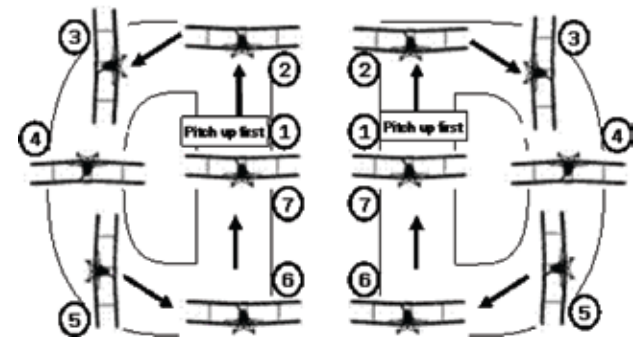
The main difference between the slow roll and the aileron roll is the flight path during the roll. During the slow roll, if the aircraft was reduced to a dot at the center of gravity (CG), the *flight path* of that “dot” should make a straight line throughout the roll. Not a corkscrew flight path but a completely straight flight path. Consequently, the pilot does not pitch up first before the slow roll begins. While in the knife-edge flight portion of the slow roll, the pilot applies enough top rudder—or “sky” rudder—to hold the straight

flight path. When the aircraft is in the inverted portion of the slow roll the pilot must push enough into negative G flight to hold the straight flight path. The slow roll is not comfortable for the pilot, but as you can see, the aircraft flight controls are manipulated in such a way as to make the CG “dot” of the airplane fly that straight line.

During the aileron roll, however, the pilot pitches up first and then rolls. This gives the maneuver a corkscrew flight path while remaining on heading. The aileron roll and the barrel roll, which both have corkscrew flight paths, are not official competition figures. This is mostly due to the difficulty in judging them. Remember, in the Aresti catalog and in the world of competition aerobatics (as opposed to recreational aerobatics) the true (corkscrew) aileron roll and the barrel roll do not exist. In the Aresti (competition) world there are only two types of rolls: aileron rolls and snap rolls. Since, for competitors, the corkscrew aileron roll does not exist, they call the slow roll an aileron roll.

So let us now define the true, non-competition, coordinated, smooth, corkscrew aileron roll. I call it the Bob Hoover roll. In my mind Bob Hoover is the master of smooth, and if done correctly, the aileron roll is a smooth maneuver. As three-time U.S. National Champion Clint McHenry said, it can be a good ride for a passenger if done right. So let us define an aileron roll by what it is *not*. *It is not the slow roll*. As seen above the slow roll is not comfortable to the occupants, who are falling to one side of the cockpit when top rudder is used (meaning uncoordinated) and feeling at least 1 negative G when inverted.

The two main kinds of smooth aileron rolls are the 1G and the 0G aileron rolls. First, after a good entry speed is reached, the pilot pitches up with the wings level to between 20 to 45 degrees nose-up. Bob Hoover pitched to about 60 to 70 degrees nose-up with the Shrike Commander. The power should be full at this point and remain full throughout the maneuver. Once the pitch-up target is reached the pilot must pause. This is the point where the pilot pushes the elevator control forward to establish either 1G or 0G *before* rolling. The pilot must not change this G-load as the roll input is initiated, and the G-load should stay the same throughout the roll. Maintaining this G-load is a function of the elevator control. If more than 1G is felt while the roll is happening, the pilot is pulling enough to be moving over into barrel roll territory.



The legendary Bob Hoover and his Shrike Commander.

In the case of the 0G roll, no rudder is needed with the aileron for coordination. This was covered well in Greg Koontz's article last year. In the case of the 1G aileron roll, coordinated rudder must be added with the

aileron input. In my Decathlon, I usually end up using about one-third left rudder in a left roll and one-half right rudder in a right roll with a 120-130 mph entry speed and 30-40 degrees nose-up initial pitch. The 1G

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aileron roll can really be a nice ride for a passenger since a 1G push straight into the seat cushion is felt no matter where the horizon is. A passenger also doesn't feel a side-to-side motion because coordination is maintained throughout the roll. The 1g aileron roll is what Boeing test pilot Tex Johnston used with the Boeing 707 prototype over the Seattle hydroplane races in 1955. Many of you have seen the films that show that he pitched first, then rolled. In his interview he said *if the maneuver is done right*, the maneuver is completely non-hazardous and the airplane did not know it was upside down. Bob Hoover poured ice tea into a glass when upside down!

The nose of the aircraft falls toward the center of the earth throughout the roll while 1G or 0G is maintained, but that's okay because we started with it up high. How high the nose should be brought up above the horizon before the rolling motion is started depends on how slowly that particular aircraft rolls. The slower the roll rate the higher the nose must be above the horizon

As a teaching tool, Rich will also have the student put *slow roll elements* on the above aileron roll. When the pilot gets to points 3 and 5 in the maneuver he will put in a little top (sky) rudder. It won't be enough to hold altitude, but it teaches him *when* to do it. The full rlow roll is much harder to teach than the pure aileron roll. Rich does the same at point 4 with a little push. Again, not enough push to hold altitude, but enough to teach when to do it.

Even though Tex Johnston and Bob Hoover did it, aerobatic maneuvers should not be done in airplanes not built and stressed for them. They know what they're doing. If done right the aileron roll is smooth and gentle, but it can get out of hand *fast*, and non-aerobatic aircraft can't handle the stress of the recovery.

With the previous paragraphs in mind, the tragedy of the low-time, non-aerobatic pilots is they don't know what they're doing. At too low an altitude, and in the wrong kind of aircraft, they begin a roll while showing off for friends. They

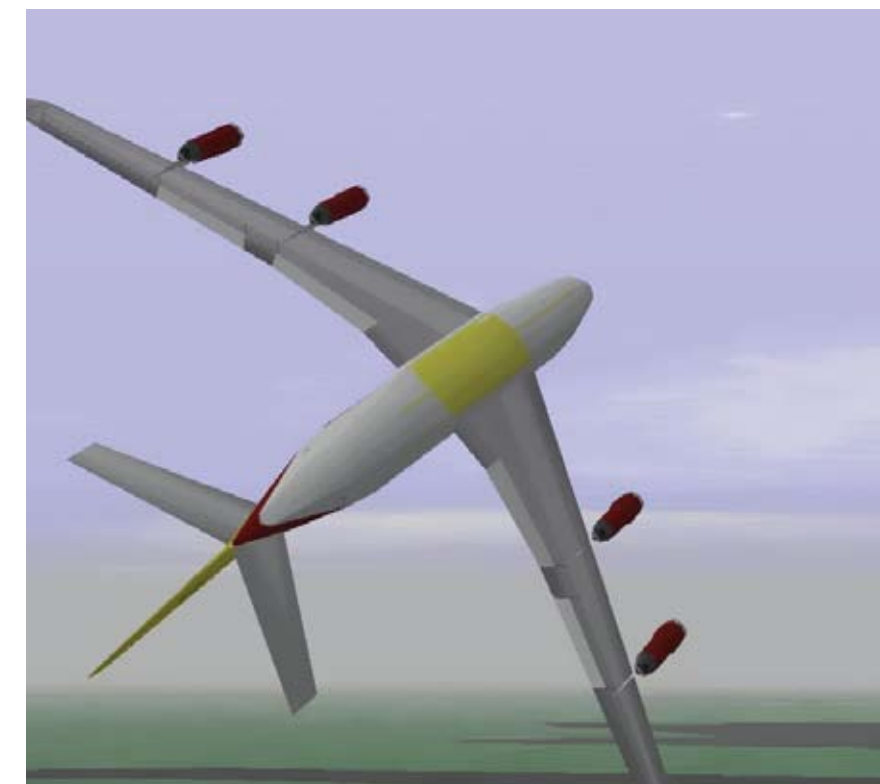
don't know enough to pitch up first. They just throw the aileron control over from level flight, and most light planes have a glacial roll rate. As they roll the nose falls. They also don't know anything about top rudder or pushing as they roll. When the aircraft is about halfway through the roll the nose is pointed almost straight down. They now begin to freak out, they stop rolling, and they begin pulling—hard. The airspeed needle is screaming around the gauge faster than a stopwatch second hand, and they are probably close to, or past,  $V_{NE}$  now. As they pull the aircraft structure begins to fail or they strike the ground. The aileron roll is an easy maneuver to teach to new people and easy on the aircraft, but do it *right, up high*, and in the *right kind of aircraft*, okay?

So, a roll is a roll is a roll is a roll, right? Not really. As you can see, each type of roll is a completely different animal. Know and respect each one. A well done aileron roll is pure joy for the recreational pilot. Enjoy, don't forget your parachutes, and fly safely! 🇺🇸

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before rolling begins. This is because when an aircraft rolls slower the nose has a longer time to fall. Starting with the nose higher than needed is better than starting with the nose lower than needed. Don't let the nose come down so far toward the end of the maneuver that never exceed speed ( $V_{NE}$ ) is exceeded.

I like the idea from Master Instructor-Aerobatics Rich Stowell that from the pilot's perspective the nose of the aircraft seems to draw a capital D during the aileron roll. The D is backward in a left roll and normal in a right roll.



A digital flight-simulator image of an actual event; Tex Johnston's famous aileron roll in the Boeing 707 "Dash80" prototype which substantially concerned Boeing's President, but delighted other onlookers.