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So You Want to Do a Low-Altitude Loop!

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When discussing the relative benefits and potential dangers of aerobatic flight, there's much to be said about its benefits. Aerobatic flight is fun, and it opens a door to pilots through which they can enter a whole new world that will take them to higher and higher levels of proficiency and competence. But aerobatics can be misused, and when that happens the consequences can be serious.

In this article I'd like to discuss both the benefits and one of the potential dangers of aerobatics — the temptation to perform them at low altitude. In a previous article I talked about the potential dangers involved in doing low-altitude rolls. In this article I'll discuss low-altitude loops.

As pilots who are interested in aerobatics, we always need to think about safety. Aerobatics and safety are inextricably linked by a common thread. However, that thread can be a bit thin when it comes to the uninitiated or novice pilot, for whom a moment of bad judgment can spell serious trouble.

I'd like to walk you through a low-altitude vertical maneuver and the danger involved when it's attempted by a nonprofessional pilot.

Temptation can be a strong and terrible force that can creep up on a pilot just as the sirens did to Odysseus. When the song of the sirens is heard by a pilot contemplating a low-altitude aerobatic maneuver, the outcome can be deadly.

To illustrate the danger involved, I'll use as my example a simple loop that might be performed from a low-altitude entry.

Believe it or not, the simple loop is one of the most dangerous maneuvers that can be done from low altitude, even by professional pilots displaying on the air show circuit. There are a lot of latent dangers lurking in this time-honored simple aerobatic maneuver.

Before I get into the negatives associated with a low-altitude loop, let me go off course for a moment and discuss aerobatics in general, because the last thing I want to do is scare you away from the sport. In fact, I'd like to encourage every pilot reading my safety articles to get involved in aerobatics. If you learn correctly from a *competent aerobatic instructor* and use properly certificated aerobatic aircraft at safe altitudes and within safe parameters, participating in aerobatics is the safest, most rewarding, and most positive way to become a better pilot.

When I taught aerobatics years ago, pilots sometimes cornered me and asked why I thought learning aerobatics was such a positive a step to take after receiving their pilot certification.

Here's the answer I liked to give them:

Several regulations in the FAR deal with aerobatic flight. Section 91.303 reads as follows:

“For the purposes of this section, aerobatic flight means an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.”

91.307 tells us the following, in part:

“(c) Unless each occupant of the aircraft is wearing an approved parachute, no pilot of a civil aircraft carrying any person (other than a crew member) may execute any intentional maneuver that exceeds—

“(1) A bank of 60 degrees relative to the horizon; or

“(2) A nose-up or nose-down attitude of 30 degrees relative to the horizon.”

As a flight instructor I find subsections (1) and (2) of 91.307 interesting not so much for their reference to parachutes but for a less obvious reason.

Let’s talk about those 60 degrees of bank and 30 degrees of pitch for a moment.

These two “limits” define in what situations parachutes must be worn by pilots, without exception. Fair enough.

These two pitch and bank limits represent the outside limits for an envelope within which many pilots learn to fly — limits that they then continue to observe during their entire tenure as pilots. This doesn’t mean to imply that pilots who choose to fly within these parameters are unsafe. What it does mean is that there is a whole world of flight available outside these limits that not only can be fun to explore but can also provide an invaluable experience that can take a good pilot and turn him or her into a much safer and better pilot.

My point is that, for you nonaerobatic pilots out there, learning aerobatics or taking a basic upset recovery course will not only open a new and exciting world for you but also make you a better straight-and-level pilot — and that is a *very* positive step toward becoming a safer pilot.

I should add that if you choose to get aerobatic training, and I highly recommend that you do, by all means you should seek out a qualified aerobatic school and a competent instructor. This is critical.



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Not all CFIs are aerobatic instructors, and neither are most pilots. An aerobatic instructor is a specialist, and no effort should be spared in finding the right one to guide you through your training. If you don’t know of a good aerobatic instructor, a simple phone call to the EAA or other reliable source should provide you with solid recommendations.

Now that I’ve covered the good about aerobatics, let’s take a look at the bad and the ugly. We find these traits when we begin to discuss aerobatics performed at low altitude by nonprofessional pilots.

I covered the inherent danger involved with low-altitude rolls in “So You Want to Do a Low-Altitude Roll” (*Sport Aerobatics*, December 2013). Hopefully that article discouraged any pilots reading it from ever being tempted to try one. This time around I’d like to show you the danger lying just beneath the surface if you misuse your valuable aerobatic training.

Unfortunately, we lose pilots and aircraft to unauthorized low-altitude aerobatic maneuvers almost every year. Right off the bat, I think we can agree that engaging in illegal low-altitude aerobatics is not a good idea.

Let’s set up an example so that we can all see what can happen if aerobatic flight training is misused.

For our example let’s create a fictional pilot with a hypothetical instrument rating and a commercial certificate. Our guy flies well and is usually pretty safe. He decided (apparently he didn’t read this article) to get some aerobatic time from a CFI with limited aerobatic experience. I’ll call my hypothetical pilot

Joe Average.

Let’s meet Joe.

Joe is a nice regular guy who has just purchased a tandem two-place aerobatic trainer in which he completed his tailwheel endorsement. The plane is a basic aerobatic trainer.

Let’s learn a bit more about Joe.

Young and eager to learn about his new airplane, Joe asks his CFI to teach him “a few things about aerobatics.” Joe has reached a certain basic level of competence at altitude, and his maneuvers aren’t all that bad. In fact, Joe believes he’s done fairly well with his aerobatics and is proud of what he’s learned in a short time. I think it’s safe to say that Joe feels confident, but as we shall soon see, Joe’s “confidence” is about to mislead him into making a very bad decision.

Going into what is destined to become a very sad day for Joe, we find him VFR at cruise altitude returning to his home field from one of those famous \$100 hamburger flights. He’s solo and thoroughly enjoying his flight home.

It’s a summer day around 2 p.m. and it’s hot ... *really* hot! A summer storm is forecast for later in the afternoon near Joe’s home field, but he’s not worried because he’ll be back on the ground enjoying a cold Coke with the airport gang before that.

Joe has racked up about 20 hours in his airplane now and really likes it. He’s also flown five hours of dual with his “aerobatic instructor” and has a fairly good working knowledge of basic rolls and loops, having done a few spins as well.

Feeling really good, and with plenty of altitude under him, Joe looks around, makes two alternating clearing turns, and performs a fairly nice on-course aileron roll just for fun. That felt really good, and Joe silently reflects on his decision to opt for the two-place aerobatic plane instead of the four-place he had considered purchasing.

If we look carefully, we can see the beginning of what shortly will

be a very bad moment for Joe.

By doing that aileron roll and doing it well, Joe gave himself a boost of confidence. In other words, Joe is feeling his oats and feeling pretty good about his aerobatic ability. Joe feels at one with his plane, and without really noticing it, he's allowed his level of confidence to exceed that of his basic aerobatic skill — which is *very* dangerous for Joe.

Almost home now, he approaches the field.

Over the field, he looks down and sees his friends and the airport gang gathered around the picnic table looking up at him. And at that moment, Joe makes the most important decision of his life — the wrong decision!

Joe's airport consists of a small grass strip with UNICOM, and he already knows from monitoring the frequency that there is no one in the pattern, nor has he heard anyone call in for wind direction. Looking around he notes that the sky is clear for miles. "Why not?!"

For some reason that even he doesn't understand, Joe, having already done a roll that psyched him up a notch or two, decides that he'll loop the airplane over the runway. Smiling to himself, he thinks that

doing this maneuver should raise his standing a bit with his buddies. He's done enough loops at an altitude where he felt comfortable doing them, and after all, what can be easier than doing a loop in his new toy? At 140 mph and a nice 3.5g pull, around it goes — real pretty!

To make the loop look as beautiful and exciting as possible for the folks on the ground, Joe decides to start it low over the runway.

Let's stop here for a moment and look at Joe's situation. A normal loop radius for his aircraft — if he's initiating at 140 mph with a 3.5g profile in the pull at, say, 50 feet over the runway — should put Joe through the top at around 800 to 850 feet AGL.

At altitude, Joe could do his loop all day long using these numbers and the results might vary a bit on the back side, depending on how and where he eased the pull and tightened it a bit, but down low and especially today, he can't settle for a "slight variation" on the recovery.

It's important to note here that professional air show pilots doing loops from low altitude will carry extra airspeed to initiate into the vertical plane, then play the g to meet or preferably exceed a minimum AGL high-energy gate. To

a pro executing an air show loop, doing it in an exact circle isn't the prime directive. To pros, safety is the prime directive, so they use airspeed and play their uplines to meet a stringent and firm set of airspeed and minimum AGL altitude numbers called a high-energy gate. Air show loops are usually oval in shape for this reason, as opposed to perfectly round as we like to think of them when judges are there to critique that perfect circle. The professional has done his or her homework on any density altitude issues that might be in play because IAS is IAS, but turn radius is predicated on true airspeed (TAS) and g, and TAS is higher with density altitude in the equation, and that will result in a wider turn radius that can have serious consequences in a low-altitude loop. Density altitude will play into what Joe is about to do, as it's very hot out there today.

How? Well, his airplane's performance will be less than he expects it to be. His prop will be putting out less thrust. His engine will be putting out less power, and his wings will be producing less lift than normal. His airplane's control surfaces won't grab as much air as they usually do, and control pressures will

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produce less response. All in all, we can safely say that literally everything connected to Joe's loop that takes density altitude into account can be considered downgraded.

So Joe lines up with the runway and sets up for his loop. He's okay for a loop entry on his airspeed indicator as he crosses the end of the runway. His scan has fixated on the ground, where the speed looks great, as he "senses it" from being that low, so he takes one last look at the gang at the picnic table, smiles to himself, and initiates. He's at 50 feet AGL!

Let's stop here for a moment and take a closer look at what is happening.

In the world of the professional display pilot, it can truly be said that in a loop maneuver initiated from the ground you can kill yourself at two places — at entry on the bottom if your numbers are wrong and at the top for the same reason. Display pilots know these numbers exactly, and when they fly a loop from the ground they usually pull a bit harder as they initiate to establish good rate on the upline, play the g and airspeed to arrive at their mins and even higher AGL high-energy gate inverted, play the back side with harder pull while the airspeed allows that, and then feather out the recovery during the last 75 degrees or so. The main point for the display pilot in recovery is that he or she doesn't want to be pulling g through that last 75 degrees of recovery. In fact, a good air show pilot will actually release g during that last part of the loop recovery.

But alas, our Joe isn't a display pilot, and he isn't a professional.

Joe pulls from habit and feel to his $3.5g$'s. He feels the airplane, and it feels okay so far. As Joe continues with his pull, the airplane is not performing quite as well as usual because of the hot, damp air. His TAS is higher than normal due to the density altitude, but Joe fails to notice it as he looks at his indicated airspeed rate decrease, which

looks normal. But turn radius is a function of TAS and g , not IAS, and Joe ends up inverted at the top at 800 feet instead of his 850, and he's going through the top faster than his airspeed indicator is telling him. He's at his high-energy gate low on altitude as he pulled a bit too hard in his second 90 degrees and he's fast on true airspeed. Hidden in this aerodynamic equation is a killer with a death wish called increased turn radius!

Joe can still save himself if he rolls out and calls it a day, but the loop feels okay, and he decides to commit. Consider also that Joe is looking at the ground sight picture inverted from a much lower altitude perspective than he has ever experienced it before, and that is skewing his recovery visuals. Everything "feels" okay, and he doesn't want to look bad in front of all those friends of his on the ground. In Joe's mind the first half of his loop went off quite well.

So Joe pulls!

As I said before, you get two shots at doing a low-altitude loop correctly — one at the bottom and one again at the top. Get it wrong at the top and you *will* stub your toe!

Joe made his big mistake doing the loop to begin with, but aside from that, not realizing that the density altitude was causing his aircraft to perform differently than usual in *all* aspects has doomed him.

So here's Joe arriving inverted at the top of his loop faster than he should be and lower than he should be — and with some density altitude issues on top of all that. We now find him beginning his pull through inverted on into his downline on the back side.

He has committed the airplane. As he reaches his 270-degree point in his loop, Joe has killed himself.

I could go into a long song and dance concerning corner velocity as an added factor, but with Joe committed at the 270 with a high TAS and an increased turn radius, why bother?

So what's the overall message?

Well, obviously it's a safety message. We can't save Joe. He's become a statistic, but we *can* learn from Joe's experience, and that's a positive lesson.

To summarize, I think everybody can agree that even if it were legal to do a loop whenever and wherever you wanted to do one, low-altitude aerobatics, and especially loops, are best left to the professionals. The risks for the novice pilot are too high. If your numbers are wrong at the bottom, you're in trouble. If your numbers are bad on the way up, you're in trouble. If the numbers through the top are off either too slow or too fast or you're low AGL, you're in trouble. Once committed to the back side with bad numbers, worrying about trouble is a waste of time.

So don't be like Joe. Leave the low-altitude stuff to the pros.

Well, that's the bad and the ugly of low-altitude loops ... and low-altitude aerobatics in general.

On the positive side, I sincerely hope all you pilots will be motivated to go out and get some good aerobatic instruction from competent instructors.

We need more pilots out here with experience in all areas of flight, and like I said, aerobatics is fun.

If you are on the East Coast, I highly recommend my good friend Patty Wagstaff and her school in St. Augustine, Florida. You won't find a better learning experience anywhere on the planet. You can reach her at pattyaerobatics@gmail.com.

If you are out west, I highly recommend Rich Stowell at RichStowell.com. Rich is widely considered one of the finest aerobatic instructors in the world.

These are just two of the many competent aerobatic instructors available. If you don't live near Patty or Rich, you can call EAA at any time and get a good recommendation for your area.

Climb high, have fun, and above all *stay safe!*

