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URBAN "AIR" LEGENDS

Debunking Aircraft Performance Myths

Photo by James Williams

"As long as I stay in the yellow arc, my airplane can handle a little rough air."

"It's only a tiny bit of frost on the wings. We can still take off."

"If you inadvertently spin, just let go of the controls."

"We're below V_A, I'm safe to make whatever control inputs I need."

Any of these sound familiar? Most general aviation pilots will admit to hearing at least one (or more) of these common aircraft performance myths during their flying careers. These myths can originate for any number of reasons: a lack of knowledge, training miscues, uncorrected bad habits, laziness, and yes, the infamous pilot bravado. While helping you dial down your machismo is a bit out of scope for this article, we can, however, provide some tips to help debunk some of the more popular urban "air" legends out there.

We Should Be Able to Clear Those Trees — No Problem

In the May/June 2009 *FAA Safety Briefing*, aerospace engineer David Schwartz relayed a stirring personal account of a "run-in" he and his plane had with a tree at the end of a runway. Spoiler alert: The tree won. Unfortunately, they usually do. By sharing his tale with fellow pilots, Schwartz was able to leverage this ego-bruising moment to highlight his mistakes and point out some key takeoff performance metrics that are often underestimated or taken for granted.

The tree that had Schwartz's number that day was a modest ten feet high. As pilots sometimes do, Schwartz admits he was focused more on takeoff distance than on what obstacles were lurking at the end of runway. With the relatively flat climb angles of most small airplanes, that's an important element not to overlook. "Even though 'the book' said it would be tight, I thought that I could make it because the trees weren't that tall," said Schwartz.

So how exactly are we supposed to measure obstacles at the end of a runway? There are a few good resources that can help including the Airport/Facility Directory, instrument approach plates, or even asking airport personnel or fellow flyers. In most cases it's probably easier (and safer!) to err on the side of caution and be conservative with your estimates. Here's a simple method Schwartz suggests using to get a ballpark idea on the height of a tree:

- Fold a piece of paper into a 45-degree triangle.
- Sight along the diagonal edge as you walk toward the tree.
- When you see the tree top along the diagonal edge of the paper, the tree height is equal to your distance from it, plus your height.

After you know the height of your obstacle, it's time to make sure you can clear it. You'll want to check your Pilot's Operating Handbook (POH)/Aircraft Flight Manual (AFM) for the difference between the ground-run distance and the takeoff over a 50-foot obstacle distance. Here's the example Schwartz used: A Piper *Super Cub* POH has a published 200-foot ground roll, with a total takeoff distance of 500 feet to get over a 50-foot obstacle. So, it takes 300 feet from liftoff to clear the obstacle. This means that over a 100-foot obstacle, you would need about 800 feet (500 feet for the first 50 feet, plus an additional 300 for the next 50).

Keep in mind that certain runway conditions like grass, soft ground, or snow will require a correction factor, generally on the order of 15 percent. Check what's appropriate for your specific aircraft. Even if a runway seems dry, beware of hidden puddles that could hamper your acceleration. And it's not just what's on the runway that can hurt your performance. In the colder months, be sure your aircraft is free from any contaminants. Even the slightest bit of frost, ice, or snow can reduce lift by 30 percent and increase drag by 40 percent.

Wind is another factor sometimes misunderstood when calculating takeoff performance. Tailwinds on takeoff are bad of course, but knowing just how bad is critical. If your airplane's POH/AFM doesn't have tailwind correction factors, Schwartz suggests that for every 10 percent of the takeoff speed, a tailwind will increase the ground run by about 21 percent. Then again, it's probably best to just not takeoff with a tailwind.

Less obvious is the impact of crosswinds which can rob performance by introducing additional drag via corrective control surface inputs and tires. And while headwinds generally improve takeoff performance, don't be overly confident of that extra boost. They could shift or drop off rapidly after becoming airborne.

Remember, the results you get from takeoff and landing calculations are never an absolute. It's best to always assume it'll be longer than you calculate. A good rule of thumb is to add 50 percent to your numbers.

Put a Spin On It

Pilots are often unaware of, or do not fully appreciate what goes into the certification of light airplanes with regard to stall and spin behavior. Many might think that by the time designers and lawyers get done with a particular design, the published operating envelope is a lot smaller than it actually is.

But nothing could be farther from the truth! It is in the best interest of airplane manufacturers to provide their customers with as much operating envelope as can be squeezed out of their designs; consequently, there may not be as much "cushion" as pilots might think.

NASA spin tests of a Cessna 172, for example, revealed a steadily increasing probability of successful spin entries (given pro-spin inputs) as the center of gravity moved from the forward to the aft limit. Moreover, test pilots encountered unrecoverable spins when the aircraft was loaded just five percent beyond the manufacturer's aft limit.

Photo by James Williams

With the relatively flat climb angles of most small airplanes, it's important to not overlook the height of obstacles at the end of a runway.

While we're on the subject, a placard prohibiting intentional spins means an airplane has only demonstrated recovery from a one-turn (or three-second) spin within one additional turn. Beyond the first turn (or three seconds), spin recovery may be impossible; the pilot becomes a test pilot at that point. And even in airplanes approved for intentional spins, if you're not following the right procedures, or if you operate outside the weight and CG envelope (both of which are not that hard to do) you may not be able to recover. There is also no certification requirement for spin-certified airplanes to demonstrate recovery from aggravated or flat spins.

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As harmless as it may seem, it can be dangerous to infer one airplane's stall/spin behavior based on similarities in appearance with another airplane. This is especially true if the airplane has been modified in any way, or is experimental/amateur-built. As far as stall/spin behavior is concerned, looks can be deceiving, even deadly: avoid the temptation to assume that the reported stall/spin behavior of a similar airplane can be applied to the one you fly.

Another spin myth worth pointing out is that simply letting go of the controls during an inadvertent spin will help you to recover. In addition to this being a completely unnatural reaction to such an event, it can have inconsistent results. Early release of the controls during a spin might work in some aircraft, but letting go too late or under some different conditions may result in the inability to recover.

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Photo by H. Dean Chamberlain

Furthermore, most inadvertent spins occur at pattern altitude. Letting go to recover then may result in more altitude loss than you would with making a prompt and properly exercised recovery maneuver.

Watch This!

Those are the two words you probably never want to hear in an airplane. They usually precede a series of "stupid pilot tricks" that can quickly bring an aircraft to the brink of its breaking point. As we stated with spins earlier, there's a common misconception among pilots that manufacturers build in plenty of cushion in terms of load limits, and that what's in the POH/AFM is probably just a conservative estimate.

One operating limitation in particular that's misunderstood is maneuvering speed (V_A). A common and unfortunate pattern that seems to have pervaded many a pilot's thinking on VA is that they can "yank and bank" on the controls with impunity. Not so.

A wake-up call to the pilot community on the error of this thinking occurred shortly after American Airlines Flight 587 crashed into Belle Harbor, a neighborhood just outside of JFK airport in Queens. The NTSB concluded that the crash, which killed 265 people, was due to the Airbus A300 co-pilot's overuse of the rudder to counter wake turbulence.

"The American 587 accident was a landmark case for 'paradigm shifting without a clutch' for almost all pilots," says FAA Aerospace Engineer Peter Rouse. "We have been trained that V_A was the speed in which there were no limits on the number of times a full, abrupt control input could be accomplished."

To help clarify the meaning of V_A and caution pilots about what to avoid, the FAA published Special Airworthiness Information Bulletin (SAIB) CE-11-17 in 2011. The SAIB defines V_A as the following:

> *The design maneuvering speed (V_A) is the speed below which you can move a single flight control, one time, to its full deflection, for one axis of airplane rotation only (pitch, roll or yaw), in smooth air, without risk of damage to the airplane.*

Even though the accident discussed above is a part 25 airplane, V_A is applicable to part 23, CAR 3, and light-sport airplanes. Also, even though experimental airplanes may not have a published V_A, they will still have some maximum maneuvering speed associated with the maximum structural design loads.

The SAIB goes on to recommend that when maneuvering at or below V_A, pilots should not apply a full deflection of a control, followed immediately by a full deflection in the opposite direction, or apply full multiple control inputs simultaneously; i.e., pitch, roll and yaw simultaneously, or in any combination thereof. The regulations do not require the manufacturers to make airplanes strong enough to withstand those types of forces.

Though it seems counterintuitive, it's important to note that V_A decreases when your total aircraft weight decreases. For example, V_A may be 100 knots when an airplane is heavily loaded, but only 90 knots when the load is light. You have Newton's Second Law of Motion (F=ma) to thank for that.

A final tip on maneuvering in flight: the yellow arc on your airspeed indicator is for *smooth air only*. While you may feel your airplane is sturdy enough to handle a bit of rough air in the yellow, know that you're going beyond what any flight test pilot has experienced on your aircraft. It may not cause your airplane to break apart, but it can subject it to forces that lead to accelerated fatigue.

Myths-busted!

Hopefully this article gave you some helpful information to think about with regard to some of the popular "tall tales" of aviation. The key to many of these myths is to understand where a particular performance limit comes from in the first place. By better understanding the context and background with why and how certain behaviors exist, you'll be well on your way to making safer decisions.

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Learn More

FAA Special Airworthiness Information Bulletin CE-11-17
http://go.usa.gov/3rMNP