Thomas P. Turner's
Mastery of Flight

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FLYING LESSONS for March 14, 2024

FLYING LESSONS uses recent mishap reports to consider what *might* have contributed to accidents, so you can make better decisions if you face similar circumstances. In most cases design characteristics of a specific airplane have little direct bearing on the possible causes of aircraft accidents—but knowing how your airplane's systems respond can make the difference in your success as the scenario unfolds. So apply these *FLYING LESSONS* to the specific airplane you fly. Verify all technical information before applying it to your aircraft or operation, with manufacturers' data and recommendations taking precedence. **You are pilot in command and are ultimately responsible for the decisions you make.**

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This week's LESSONS:

In the February 29th Mastery of Flight report we discussed the significant, negative performance impact of taking off and landing with a tailwind. Using Cessna and Beechcraft performance charts as examples, we postulated that ***tailwinds have a roughly three to five times greater impact on takeoff and landing performance, negatively, than do headwinds improve takeoff performance***. In other words, a little headwind helps a little, but a little tailwind hurts a lot.

See https://thomaspturner.com/wp-content/uploads/2024/02/2024.0229-FLYING-LESSONS.pdf

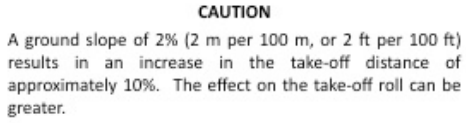
But sometimes it makes sense to intentionally take off or land with a tailwind. For one, the runway may be so long that there is no doubt the airplane will become airborne or come to a stop on landing in the available runway length even with a tailwind. In that case it may be better to conform to ATC's direction, local noise abatement procedures or other airplanes' traffic patterns with a tailwind than it is to go against the grain just to have a headwind component.

Another case when intentional tailwind takeoffs and landings make sense are so-called "one-way" airports, those that because of local terrain or obstacles require taking off and landing in one compass direction—landing to the west and taking off to the east to avoid a hill off the west end of the airport, for instance.

A third situation is when there is a significant slope to the runway. A runway that climbs or descends steeply with horizontal distance will adversely affect airplane performance with or without a wind. The slope may be enough to make an airport a "one-way" strip, at least for some airplanes, with or without obstacles close to the departure ends.

So how can you decide whether a runway is one-way because of runway slope? Most Pilot's Operating Handbooks assume a level runway surface on their Takeoff and Landing Performance charts…in other words, **you're on your own** to predict performance when the runway has a slope.

Diamond Aircraft's DA-40-180 POH, however, does give us some guidance. Look at this Caution. **A 2% up slope** (a change in elevation of two feet per 100 feet of horizontal distance, or two meters for each 100 meters) **creates a 10% increase in takeoff distance**. The effect on the takeoff roll may be even greater, i.e., the distance to take off and clear an obstacle increases 10% with a 2% slope but the airplane will roll even more above


CAUTION

A ground slope of 2% (2 m per 100 m, or 2 ft per 100 ft) results in an increase in the take-off distance of approximately 10%. The effect on the take-off roll can be greater.

"book" distance before the wheels leave the surface. ***The POH doesn't tell us***, but it's not too much of a stretch to expect the performance to increase by a similar percentage if you take off downhill on a 2% slope. Certainly **it would be worth experimenting *under controlled conditions*** with a very light airplane and a long, downward-sloping runway before tacking a short, downhill runway for real.

Diamond has a similar note in the DiamondStar's landing performance discussion, identical except that it replaces "take-off" with "landing" as appropriate.

Now let's consider winds from last week's discussion. Two knots of tailwind component is worth roughly 10% change in airplane performance (using the Cessna and Beech charts as examples). Consequently **it takes about two knots of tailwind component to balance the effect of taking off downhill on a 2% slope or landing up a 2% slope** (using the Diamond Aircraft POH as a single data point).

What's the practical application of this estimate? Conventional wisdom is that it's better to take off downhill and land uphill than to take off and land into the wind on sloping runways. However, this (very) preliminary correlation of various POH data suggests that **the amount of tailwind it takes to make even a downhill landing or uphill takeoff a bad idea is very slight**—just a couple of knots. ***It seems a good idea to take off and land into to wind even with a 2% runway slope.***

Sometimes, with safe experimentation, we learn the limits of POH-derived performance when the charts don't cover all the variables. Then we can ***make our own, informed decisions*** **about what works for us in our airplanes**. For example, for a few years I flew a turbocharged Baron from a short runway (3400 feet, short in 58TC terms, anyway) with a little more than a 3% slope. With practice at weights as light as I could get, I found that it indeed *was* more comfortable landing uphill and taking off downhill from that airport, with tailwind components up to as much as about 10 knots.

Perhaps some readers are more familiar with the physics than I and have done the math, and can provide definitive answers. It seems likely, however, that the degradation in performance working against a runway slope is not additive, but instead multiplicative with slope. Regardless, empirical data told me it made sense to take off and land with slight tailwind components on that particular runway. Regardless, I tried to fly the airplane as light as safely possible, especially on landing—the turbo Baron has a lot of inertia that makes landing distance more critical than takeoff in that specific model.

I strongly suspect, however, that ***simply flying the airplane at the appropriate speeds for liftoff and final approach will do more*** to assure you can use a runway that meets your airplane's needs than any additional benefit that derives from playing the tailwind-vs-runway slope game. **With or into the wind,** apply no less than a 50% margin to what you calculate, and 100% additional buffer if you don't use maximum performance, short-field technique.

Are you faced with a similar decision? Don't "wing it," don't do it because someone on the internet (like me) or the local ace tells you to, and certainly **don't try it simply *hoping* you'll get the performance you need.** Gather as much available information as possible, using data from your POH as primary but not completely discounting very general rules of thumb from others to help you fill the gaps. Then **conduct some controlled experiments** at light airplane weights and ***varying the variables*** as few at a time as possible, being ready to chop the power and **abort a takeoff early** if you don't get the initial performance you need, and to power up and **go around** at all points of the landing attempt, including after the wheels are on the runway if necessary.

If you're not willing to educate yourself and conduct controlled experiments, doing your homework, calculating the performance, then reducing the margins of wind, weight, slope and distance only a little at a time, then don't try the unusual at all.

Airplanes usually fly extremely well in the middle of their approved performance ranges. For almost all of us, almost all of the time, there's no need to get close to the edges of the envelope.

Questions? Comments? Supportable opinions? Let us know at mastery.flight.training@cox.net.

Debrief: Readers write about recent *FLYING LESSONS:*

Reader Dave Murlin writes about last week's discussion about bounced landings and my **One Bounce Rule**:

> Regarding the Musketeer crash: Not mentioned in the report was whether or not the pilot applied any right rudder during the attempted go-around. **He NEEDED to apply FULL right rudder** to maintain control of the plane during his attempted go-around. Since he went to the left, obviously he did not. Also not mentioned in the report is the pilot's level of experience. I suspect that he is a low time pilot. Unfortunately one of the best ways we pilots gain experience is by making mistakes and surviving them. I have had a few such "learning experiences." Hopefully this pilot will chalk it up to experience and continue to fly.

The NTSB report that was inspiration for last week's *LESSONS* tells us the 55 year old Private Pilot had, at the time of the crash:

> 348 hours (Total, all aircraft), 346 hours (Total, this make and model), 299 hours (Pilot in Command, all aircraft), 2 hours (last 90 days, all aircraft), 2 hours (last 30 days, all aircraft), 2 hours (last 24 hours, all aircraft). His most recent Flight Review was endorsed 13 months prior to the accident and his most recent FAA medical exam about five months before that.

I'll leave it to you to decide whether that means "low time" or if the fact almost all his flying experience was in the same make and model aircraft (likely, the accident airplane). We won't know how he controlled the airplane as it drifted to the left unless the pilot volunteers the information beyond what he apparently told the NTSB.

But you're right. If the airplane was to be controllable after the bounce the pilot would have to have aggressively manage **pitch** for airspeed and control authority, and **rudder** to turn that potential control authority into aircraft command. I agree, Dave: I hope he continues to fly as well. Thank you.

See:
https://thomaspturner.com/wp-content/uploads/2024/03/2024.0307-FLYING-LESSONS.pdf
https://thomaspturner.com/wp-content/uploads/2024/03/One-Bounce-Rule.pdf
https://thomaspturner.com/wp-content/uploads/2024/03/2024.0202-B23-AR-FINAL.pdf

Reader Mark Finkelstein continues on the main topic of last week's *LESSONS*, pilot induced oscillation (PIO):

> Your post about PIOs and your One Bounce Rule was excellent and very timely. I only wish I had read it a few weeks ago.
>
> I pranged my Jabiru J230-D Light Sport off the nose on landing, and it began to bounce. I knew that the standard procedure was to apply power and initiate a go-around. However, **I was**

> **concerned that I might apply power at the wrong point in the oscillation**, while the plane was heading back down, and drive it into the runway. And so, I just rode it out, without making any attitude adjustments. Luckily, after the third bounce, the plane settled onto the runway.
>
> Should I have applied power regardless of the stage of the oscillation? Or should I have waited till the nose was pointing up, pushed it down, and applied power then? Many thanks from a longtime MFT reader!

I believe your instincts are correct: establish the pitch and feed in the power. You were doing something right to manage pitch as the Jaribu settled back into control to touch down without damage. Good job, Mark.

Well-known instructor Mike Jesch adds:

> Another excellent letter indeed. One thing I'd add on the bounced landing go around discussion: **I always hate making A or B decisions in the heat of the moment.** I prefer to have the options identified, which you did, but I also like to ***identify clearly the point at which that decision should be made***. If the option to attempt to recover from a bounce and continue to a landing is viable - if sufficient runway remains - that can and probably **should be decided before the bounce occurs**. During the preparation and briefing for the landing, it should be decided whether a bounce recovery can be attempted, or if the go around should be automatic.

That's a good point, but also requires additional thought and planning. Can you give us an example of how you make the decision? Is it solely based on remaining runway length? Thanks very much, Mike.

Tailwheel and high-performance instruction specialist Brian Sagi wraps up this week's Debrief:

> Another excellent post!
>
> **The cure for Pilot Induced Oscillations (PIO) is to hold the controls steady.** If appropriate, simply let go of the controls! In the air in a general aviation, this will cure all PIO. Of course, close to the ground, the pilot must exercise judgement and hold the controls **steady at a state that is appropriate** (e.g., and referring to the videos you referenced, in a nose up for a go-around, as the NASA F-8 fly-by-wire pilot, or as appropriate for a landing, as the Boeing 777 pilot did). I like your "decision" tree discussion because it prevents the forming of PIO, by allowing no more than one bounce. Here is but one example of what happens when additional bounces are allowed.
>
> As part of the training I give to budding tailwheel pilots, in the latter parts of the tailwheel endorsement training we **simulate landing errors**. We induce an error on purpose and **learn how assess it**. We learn to judge landing errors **and determine if an error is "salvageable"** (and how to salvage it), or if it required an immediate go-around (and how to safely conduct that go-around). In my opinion, this is an essential piloting skill because, **sooner or later we will make a judgment error when landing. *Training and experience will determine* how we recover from such an error.**
>
> While tricycle gear aircraft are more forgiving of landing errors than tailwheel aircraft, practicing "bad landing" recognition and recovery in tricycle gear aircraft is also very beneficial.

I did the same thing when I conducted primary training, and when I also provided tailwheel endorsement training. I need to include potential landing errors in recurrent and Flight Review instruction. Thanks for prompting me, Brian, and for letting us all learn from your experience.

See https://www.youtube.com/watch?v=NMmHYWjEmkY

More to say? Let us learn from you, at **mastery.flight.training@cox.net**.

See https://nafi.memberclicks.net/join-nafi-now

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