FLYING LESSONS for May 9, 2019

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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 almost all 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 as a 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:

The image of a chartered Boeing 737 partially submerged in a river off the end of the long runway at Jacksonville, Florida, has made the rounds of online news and chatlines this week.

Happily there were minor injuries only, and to only two of the 142 passengers and crew aboard.

Many factors likely contributed to the runway excursion. We'll have to wait for the NTSB's investigation to know more.

As is usually the case, this event nonetheless suggests *LESSONS* that can help us avoid similar runway excursions. Read on.

See https://www.usatoday.com/story/news/nation/2019/05/04/florida-plane-crash-survivor-landing-guantanamo-bay-cuba/1100290001/

Keeping an airplane on the runway during takeoff and especially landing continues to be a challenging prospect for many pilots, according to mishaps reports and contacts in the insurance industry. Runway directional control is a function of controlling the effects of wind, runway surface, dynamic aircraft forces (propeller tendencies, tail design, tailwheel, wing loading, etc.) and aircraft malfunctions (tires, brakes, engines, controls).

We've addressed all these factors many times in the 21 years of *FLYING LESSONS Weekly* and its predecessor online reports. In the case of the Jacksonville mishap, there is much speculation that wet runway conditions may have led to ***dynamic hydroplaning*** as a primary contributor. Let's review some things to think about when landing on a wet runway, and some mitigations to help you remain on the runway and in control.

The National Aeronautics and Space Administration (NASA) teaches that ***dynamic hydroplaning*** occurs when a thin film of water builds between a tire and runway surface, and actually lifts the tire from the runway. Tires are no longer in contact with the ground; braking loses its effectiveness and you may not be able to steer the airplane at slow speeds once aerodynamic controls lose effectiveness.

See https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19660026826.pdf

Research shows that hydroplaning can occur in as little as one-tenth inch (2.5 mm) of water. NASA identifies the **hydroplaning critical speed** as ***nine times the square root of the tire pressure***. This means most light airplanes can hydroplane at as low as 50 knots. Here's a table of NASA-computed critical hydroplaning speeds:

Tire Pressure (psi)	Hydroplaning Speed (kts)
30	49
40	57
50	64
60	70
70	75
80	81

Critical Hydroplaning Speeds (source: NASA)

Common airplane tire pressure specifications are such that typical landing speeds are at or near the critical level. For example, the nominal main gear tire pressure on a Cessna 172S Skyhawk is 38 pounds per square inch (PSI) or 262 kiloPascals (kPa). This pressure results in a dynamic hydroplaning speed of 55 knots.

If you make a full stall landing in that C172S at maximum weight and with full flaps, you'll touch down at 40 knots. This gives you a healthy 15 knot margin between your touchdown speed and the speed of dynamic hydroplaning.

As airplane weight decreases the actual stalling speed will decrease as well. This gives you an even greater protective margin from dynamic hydroplaning. **A headwind helps** because the hydroplaning speed is *ground speed*. This also means **landing with a tailwind is especially risky** when landing on a wet surface.

But if you land fast—as many pilots often do—that safety margin erodes away. Not only will you use much more runway in a faster-than-full-stall landing, you'll also risk hydroplaning and an out-of-control runway excursion or overrun.

I've tabulated information from the flight manuals of a few sample airplanes: the aforementioned Cessna 172S, a Diamond DA40-180, the Cirrus SR22, the Beech A36 Bonanza and 58TC Baron.

Model	Main Tire Pressure	Speed of Hydroplaning	Max Weight Touchdown Speed*	Max Weight Margin
Cessna 172S	38 PSI	55 knots	40 KIAS	15 knots
Diamond DA40	36 PSI	53 knots	49 KIAS	4 knots
Cirrus SR22	62 PSI	71 knots	59 KIAS	12 knots
Beech A36	33 - 40 PSI	52 - 57 knots	56 KIAS	minus 4 to +1 knot
Beech 58TC	76 - 82 PSI	79 - 83 knots	77 KIAS	2 to 5 knots
	*	Published V_{SO}		

Interestingly, the Bonanzas I most commonly fly have essentially no margin above the speed of dynamic hydroplaning…and even in a full stall land above the speed of dynamic hydroplaning if tires are inflated any amount less than the maximum allowed. Landing on a wet runway, I have to assume the airplane may have no braking at all, and directional control will be difficult as the airplane decelerates to the point ailerons and rudder are ineffective. Headwinds help too!

DA40 and Baron 58TC (pressurized 58P Barons too) have extremely little hydroplaning margin, and again only if landed in a full stall. My Cirrus friends have almost as good a safety margin as the Skyhawk pilots…but I say again, *only* if landed in a full stall with full flaps.

Of course, for all models, a reduction in airplane weight adds a few knots' more margin for dynamic hydroplaning avoidance, and headwinds slow ground speed even more.

Compare your airplane's main tire pressure and its full-flap stall speed (which you should approximate at touchdown) to see if the aircraft you fly is susceptible to hydroplaning on wet runways.

Aviation legend the late Sparky Imeson provided this guidance for avoiding hydroplaning on wet runways, with a few of my notes added:

- Approach to land at the slowest airspeed consistent with safety, that is, the short-field landing technique.
- Land firmly, rather than making the smooth, "greaser-type" landing.
- Lower the nose [or tail] wheel as soon as the main wheels are firmly on the surface.
- Know the NASA critical speed [for your airplane] and avoid heavy braking above this speed.
- Retract the flaps immediately after landing to place more weight on the tires. [I caution against doing this to avoid an inadvertent gear retraction in retractable gear airplanes. Of course that would solve your hydroplaning problem].
- Divert to an alternate airport when conditions indicate hydroplaning potential on runways experiencing a strong crosswind.

See https://www.mountainflying.com/Pages/mountain-flying/hydroplaning.html

I'll add these additional suggested mitigations:

- Touch down as close to the approach end of the runway as possible to maximize available landing distance.
- Keep the airplane's tires properly inflated at the highest permissible value.
- Use full flaps when landing on wet runways, and touch down in a full stall.
- Do not land on a wet runway with a tailwind.
- If not **on speed, in landing configuration, on glidepath and aligned with the runway centerline with zero sideways drift** before you begin your landing flare, ***go around***—don't wait to see if you can salvage the landing. Respect and respond when you are in **the Go-Around Zone**.

See:
https://www.mastery-flight-training.com/20180418-flying-lessons.pdf
http://mastery-flight-training.com/go-around-zone.pdf

Most pilots these days are used to runways 75 to 100 feet or more in width, with pilots at more rural airports used to narrower runways, often around 50 feet wide. It's not terribly uncommon, however, for smaller airports to have runways as narrow as 35 feet. The wingspan of many airplanes approaches (or surpasses) this figure, so you can see the extreme need for centerline alignment and directional control in all landings but especially those when dynamic hydroplaning is a hazard.

The primary *FLYING LESSON* is that you must consciously ***choose*** **your landing surface** with knowledge of winds, runway conditions and your airplane's handling. Don't let the pilot attitude of resignation make you "give it a try" because you feel you have no other option. **Be pilot-in-command**.

Questions? Ideas? Opinions? Send them to mastery.flight.training@cox.net

Debrief: Readers write about recent *FLYING LESSONS:*

Frequent Debriefer and retired USAF C-5 Galaxy pilot/current flight instructor John Scherer writes about the March 28 *FLYING LESSONS Weekly* and what general aviation pilots can learn from the Boeing 737Max crashes:

> One of the biggest questions in my mind about the Ethiopian 737 MAX crash is **why the throttles stayed at a high power setting** throughout the flight. It seems to me is one could use attitude instrument flying (like 10 degrees of pitch in my P35 [Bonanza] with full power gives 105 mph all day everyday). ***With a known pitch attitude and power setting, the airplane could be flown without reliable airspeed indications***, stick shaker malfunction etc. I think one *LESSON* so far is to **know your aircraft** and **know the performance figures cold**.

We've learned all sorts of new things about the Max events since late March, but your comments are valid in any number of recent events involving air carrier aircraft…and of course general aviation airplanes as well. Thank you, John.

See http://www.mastery-flight-training.com/20190328-flying-lessons.pdf

Reader Michael Mahoney comments on the April 18th *LESSONS* inspired by the fuel exhaustion crash of a Cessna 172 on Long Island that left the airplane famously suspended on power lines that likely save the occupants' lives:

> Regarding the C172 that crashed after three or four IMC approach attempts: whenever my instrument instructor took me out, he'd have me fly the precision approach on the instruments all the way to the numbers (after we hit VMC of course). I've practiced this with autopilot and by hand many times since then, and it's impressive how a WAAS approach on autopilot can get you down to the ground.
>
> Given three failed approaches and low on fuel, I'd be more inclined to fly the needles into the ground instead of trying again and again and giving up at or above minimums. As long as the approach is stable and the aircraft has decent instruments it feels safer than falling out of the sky.
>
> Thanks for the articles. Always insightful!

Thank you, Michael. You're right—barring the pilot following my personal rule about when and when not to attempt an approach a second time instead of diverting, then this could have been an option. If you find yourself in dire circumstances, even if those circumstances are your own fault, sometimes creative thinking gives you the best chances when there are no more conventional choices remaining.

See:
http://mastery-flight-training.com/20190418-flying-lessons.pdf
https://pilotworkshop.com/tips/multiple-missed-approaches/

Newly subscribed reader Ron Horton adds:

> Just subscribed to your Flying Lessons newsletter and the first two issues I have read are already invaluable. The 4/18 newsletter is an EXCELLENT discussion of IFR weather minimums. In fact, one of my Instrument students wrote *"Tom Turner's Mastery of Flight email this week is like an IFR oral on weather mins..."*

Let me add one point of clarification. You wrote:

> ***Another note:*** The FAA fuel minimums require planned fuel to destination, then to the alternate. It does not mention the fuel to fly the approach at either airport…and certainly not multiple approaches. You might want to add this fuel to your reserves as well, especially if you're already flying near the maximum range of the airplane.

While the regulation (91.167) does not specify fuel for approach the [and FAA] Letter of Interpretation does. **Fuel to shoot an approach at the destination *and* the alternate *is* required**. Thank you for your work and thoroughness on this publication. I will be sharing it with my students (as a CFI/CFII) and candidates (as a Designated Pilot Examiner).

Thank *you,* Ron. That's how I like *FLYING LESSONS Weekly* to be used. More importantly, thank you for the FAA's Letter of Interpretation. These letters are hard to find…to my readers and friends in FAA leadership positions, there's got to be a better way to make these interpretations well-known to pilots and instructors. The guidance in this particular letter only makes sense…but it is not obvious in the governing regulation.

See
https://www.faa.gov/about/office_org/headquarters_offices/agc/practice_areas/regulations/interpretations/data/interps/2005/gallagher%20-%20(2005)%20legal%20interpretation.pdf

A couple of readers sent me a link to the Air Traffic Control audio recording of the flight that prompted the April 18th *LESSONS*. I'm not trying necessarily to explain what happened in that specific case—that's what the NTSB is for—but merely use high-profile events to suggest things we need to think about every time we fly. Requesting anonymity, one reader who sent the link noted this point that does bear discussion. It was a long, passionate and at times very judgmental email; I've pared it down to the positive *LESSONS* while reminding readers that the anonymous writer of this email is spot on when he emphasizes the responsibility we all accept when we assume the role of pilot-in-command, as well as the impact Air Traffic Control suggestions—no matter how well intended—can have on the outcome of a flight if the pilot does not exercise pilot-in-command decision-making authority:

> The…22 minute [recording] is a compression of 65 minutes of *horrifying* conversation between the pilot and Air Traffic Control beginning over Farmingdale [New York] and very nearly ending in catastrophe at or over JFK. JFK was closed to all other traffic until the saga…came to an end…. Airliners arriving from all over the world and low on fuel were kept waiting to land.
>
> The audio begins with the reported weather at Republic Airport in Farmingdale. Visibility was **¼ mile** which is below legal minimums to land. The weather conditions…would have made it impossible for this pilot to land anywhere within the local area. This pilot could have diverted to Stewart [New York, KSWF] or any number of airports in Connecticut where the weather conditions were much more favorable.
>
> After FOUR failed attempts to land at Republic, Air Traffic Control made the nearly cataclysmic mistake of suggesting he divert to JFK where the visibility was reported to be **1/8 mile.** The angle to this story is that public safety was put at enormous and *preventable* risk by:
>
> 1. the decision making of a careless and reckless pilot; [and]
> 2. an Air Traffic Control System, neither trained nor equipped to recognize and deal with a dangerous pilot in total denial about his situation regardless of their best intentions to be of assistance.
>
> The only way into JFK RWY 22L at that time with 1/8 mi visibility was via the CAT II & III ILS Approach procedure for which that C172 was not equipped and this pilot was [apparently] not qualified or proficient [at least as the single pilot of a C172—the pilot is reportedly a 737 First Officer for an Asian airline]. ATC clearly dropped the ball ***first*** when Approach Control suggested he come over to JFK, and ***next*** when the JFK Local Controller suggested he try for 31L after his first miss. Look at a satellite pic of JFK and notice the two fuel farm…**next to** 31L….
>
> Weather at KSWF…with one hour fuel remaining was 10 SM & 3000 BKN. Stewart approach is within the N90 TRACON so Approach ***could have*** and ***should have*** easily suggested SWF as an alternate...if they were trained to do so, which they are *not*! **This near apocalypse is as much an indictment of the limits of ATC as it is of this pilot.**

> Please link the audio to a future follow up article. I am not interested in any acknowledgement. I want our community of pilots to hear it and think twice before they find themselves in the same self-induced predicament.

ATC can be a valuable resource to reduce pilot workload during an emergency, and to provide information the stressed pilot needs in order to make better decisions. But controllers shouldn't be making the decisions—that's the genesis of the sometimes ridiculed but always appropriate phrase, "what are your intentions?" You're right on both counts, anonymous: **both pilots *and* controllers have responsibilities, and their decisions (or lack of them) have consequences.**

See https://drive.google.com/file/d/1Nr_tSO6CzsPWXUpcG1-9UeazN0q3UUKj/view

In that same April 19 report I discussed duty time restrictions because the pilot in question had had a very long day before the night emergency. There are no duty time limits at all in personal aviation; the only limit that most lightplane pilots ever encounter is the eight hours' maximum flight instruction permitted of certificated flight instructors. I adapt the National Business Aviation Association (NBAA) guidance on duty days—no more than 14 duty hours, including no more than 10 hours of flight, and adjustments for duty weeks, crossing multiple time zones and other factors—to my personal maximum 14 hours "alarm clock to engine shutdown" in recognition that the flying is a small part of most personal aviation pilot's fatigue load. Reader Charles Loyd, who has significant experience both in corporate and personal flight operations, writes:

> On duty time I respectfully disagree with the 14-hour duty time for single engine duty. For 14 hours duty for fractional operations you are in a crew environment with dispatchers and possibly dedicated weather wizards available. In single-engine, single pilot situations you have to generally handle everything all by yourself. I wrote an article for the *Cessna Flyer* magazine and my conclusion was that 12 hours was a reasonable time for this situation with no others supporting your operation.

I can't argue that, Charles—a little less time is even better. Without going into excruciating detail, among other things I won't combine Instrument Meteorological Conditions, or nighttime, with more than 10 hours since the alarm clock. The NBAA recommendations do something like this as well. It's all about knowing your limitations and accepting only that which does not require your maximum effort. Thank you.

See https://nbaa.org/wp-content/uploads/2018/01/Duty-Rest-Guidelines-for-Business-Aviation-2014.pdf

Frequent Debriefer Robert Thorson writes about the May 2 *FLYING LESSONS* discussion of cockpit electrical fires and the larger issue of when to adapt the Emergency Procedure checklists to fit the actual emergency:

> Seeing a puff of smoke from the instrument panel generally means some avionics part burned up, not necessarily a panel fire or an engine/accessory fire. You may get some consolation in knowing a stainless steel firewall exists between the engine and instrument panel.
>
> I have experienced cockpit smoke several times in different aircraft. There will be an acrid smell accompanying the puff of smoke. If you have an oxygen mask, it may be very prudent to don it at 100% flow. This is the first step in most emergency checklists. Now ***what is next?***
>
> I have to assume the aircraft was IMC and the ceiling was unknown. So in this particular case of being close to an airport, good ATC help and the resource of another aircraft with the same destination I WOULD BE HESITANT in killing the battery and alternator which not only deprives the pilot from resources but may leave him partial panel and at risk of losing control.
>
> In the end game, it is about pilots managing risk. This is where experience and mentoring are inevitable. Sometimes the outcome lies in the hands of "fate," as Ernie Gann used to say.

Although as I noted last week both the Cherokee Six and I were in clear skies, and I *think* the PA32 pilot was VFR using Flight Following, you're exactly right. I wrote:

> If you alter the steps of the Emergency Procedures checklists to fit the unique circumstances of an actual emergency, do so intentionally and with a specific purpose…not because you did not know what to do or forgot to perform the procedure.

I, too, have smelled the acrid smoke of an electrical fire in flight. As a newbie flight instructor I'd take my employer's Cessna 152s up for a quick hop after inspections and oil changes before

putting them back out on the student and rental line. One day I was taking up one of the little trainers from which our mechanic had removed the VOR indicator for overhaul—the airplane was returned to service with a logbook entry and the indicator's wiring wrapped in electrical tape.

Being a fun-loving young CFI I decided to spend the roughly 3/10ths of an hour on this test hop doing Lazy Eights. I must have messed up on the rudder and introduced some yaw (and for that matter not noticed that our mechanic had messed up and did not electrically isolate the circuit), for as I hit the apex of the maneuver I heard a very loud POP and smelled that smell you can't describe unless you experience, and then can't forget. Just a mile or so from the airport in great visual conditions, I snapped off the battery and alternator, pulled the throttle and glided in to the runway.

To your point, Robert: if this had happened in IMC in an area unfamiliar to me I may have left one radio on and taken my chances as well. In the case of the PA32-300 pilot, his circumstances may indeed have made leaving at least one radio on make sense as well. Thank you.

See:
http://mastery-flight-training.com/20190502-flying-lessons.pdf
https://www.merriam-webster.com/dictionary/lazy%20eight

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