



FLYING LESSONS for March 14, 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:

A twin-engine airplane’s pilot told reporters he was less than two miles from his destination airport when both engines quit. Attempting to land on a highway, he instead ended up a ditch, escaping unhurt despite “totaling” the airplane.

It seems like every time I read about fuel exhaustion, someone running completely out of fuel, it strikes me how frequently the pilot *almost* makes it to destination. It’s amazing how often an airplane runs out of gas within a mile or two of the planned destination airport!

A data enthusiast, I planned a detailed romp through the National Transportation Safety Board (NTSB) database to see if there is any truth to my growing assumption that fuel exhaustion is often a “just a little bit more to get home” phenomenon, and if so, if there’s some way to use this knowledge to prevent similar future events.

My friends and co-workers know I’ve been a little busy at work for a few months, and I’ve not had time to complete my survey. I have, however, made a brief, initial stab at it...and if the data are consistent over longer timeframes then my assumption may be proved correct.

I began looking by a search of all “fuel exhaustion” events in the NTSB database in the past 10 years. I quickly saw I didn’t have time to review the entire batch before this week’s edition; in the interest of time I eventually looked only at fuel exhaustion events for a single calendar year for which final (“Probable Cause”) reports are posted. I’m sometimes cynical about aircraft accidents (given that I spend so much time looking at and thinking about them). But frankly even I was surprised at how many fuel exhaustion reports I found: 56 reports, slightly more than **one on average every week**.

I read each report and noted how many occurred in or near the pattern for the planned destination airport. Removing four that involved airplanes remaining in the airport traffic pattern for the entire flight, and three more involving aerial application flights working away from a dedicated airport, I learned that 27 of the 49 reports—**55%**—occurred while the airplane was in the traffic pattern at the end of a cross-country flight. In many of those cases the airplane was on final approach when the engine (or engines) quit! In three additional cases the aircraft was within a few miles of destination and descending when the fuel ran out.

Recall that these are all fuel *exhaustion* reports, when investigation determined there was essentially no fuel remaining anywhere on board the aircraft when it crashed. So issues of switching fuel tanks near the ground, or violating limitations against descent and landing on

auxiliary fuel tanks, or fuel unporting in a steep slip are all outside the scope of that brief look at one year's record. These events were all simply **attempting to fly farther than the fueled range of the aircraft**.

In many of the reports the pilot (if he/she survived) reports having made what appears to have been thoughtful preflight fuel decisions. But they are also often based on rules of thumb ("my airplane always burns XX gallons per hour" or "it usually takes XX hours and minutes to make this trip") for considerations that are frequently variable based on power setting, altitude, mixture management technique and winds.

In many more, the pilot clearly knew he/she was running low on fuel before the gas ran out, often reporting the same to Air Traffic Control or after the fact to investigators. In other words, the pilot was aware enough of the fuel state to know trouble was near, but didn't do anything about it *soon enough* to make a difference.

Nearly half of all reported fuel exhaustions did *not* happen in the traffic pattern of the home airport. Those events almost universally occur somewhere during the en route phase of a cross-country trip, or after a missed approach and while en route to an airport half an hour or more away.

It stands out in the data that pilots are not frequently running out of fuel in the traffic pattern at airports *other* than their home 'dromes. When they push fuel to the last minutes before landing, pilots are doing so **on the flight home**.

Why might a pilot be more likely to run out of gas at the *end* of a trip home? Three things spring immediately to mind.

- **First**, most pilots get a "based aircraft" fuel discount at their home airport. There's an inherent conflict between the need to fuel up for a flight home and the fact that getting home with the least amount of fuel on board includes a financial reward.
- **Second**, I think pilots may be less likely to decide to divert for fuel on the way home. Pilots generally love to travel, but we *all* like to get home. The desire to complete a trip, perhaps coupled with incentives or stresses to be back at the office or in the home, may make us less likely to stop short just as we're within 30 to 45 minutes (our legal reserves) of destination.
- **Third**, fueling away from home can sometimes be a hassle. We might not want to take the time or make the effort to fuel up if we think we can make it home with what we've got. Under external or self-imposed pressure to get home, we're less tolerant of delay, and can more easily rationalize going unrefueled if for any reason we are unable (or unwilling) to get gas at the remote location.

There are many potential *FLYING LESSONS* in this realization, including:

- We can plan expected fuel burn, but we need to **actively monitor fuel burn in flight** using as many independent means as possible to account for changes in power setting, mixture technique, and real-world winds aloft.
- We need to **consider the added fuel burn of takeoff and climb** when planning a near-maximum-range flight. Rules of thumb about cruise fuel burn rates won't cut it when we're cutting it short.
- We must **consider our planned reserve an inviolate emergency resource**. In other words, if an in-flight check of fuel state shows you'll begin burning into your 30 minute-, 45 minute- or more conservative personal fuel reserves, you must remain in a position to land for gas **before** you access **the first** portion of your reserve fuel. ***Fuel reserves are for emergencies, not for convenience.***

There are likely many more *LESSONS* here. I invite you to suggest more. This was a very quick look at a small subset of accident reports, and I can't make any definitive statements yet. As time permits, however, I hope to make a much more thorough review of NTSB fuel exhaustion reports to provide definitive data...that may then be turned into data-driven *LESSONS* for instructors and students for initial training and Flight Reviews.

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



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Debrief: Readers write about recent *FLYING LESSONS*:

Reader Barbara Reed writes about the Debrief in the [February 21 *FLYING LESSONS Weekly*](#), in which a reader and I discussed landings with a tailwind and I noted the pilot should go around if not down at 1000 feet from the runway threshold or one-third the total runway distance, whichever is less:

As always, well worth reading. I would make two comments: one, about the touchdown zone. I fly a fairly slippery taildragger (used to have a Cub, so slippery is new to me) from a short grass strip with a displaced threshold. I can't afford the luxury of landing 100 metres beyond the 'V' markers so I'll be rounding out between the start of the strip and the markers with the intention of touching down on the markers minus nothing plus five metres. I think from what I see on US charts you generally have more room than we do, and more hard runways. Do you think this makes people more relaxed about landing long? A third of our runway plus 100 yards would leave me 350 metres to stop. Our airfield is pretty typical rather wider than most, but at 720 metres about average for length. In a light wind I would be sweating it.

I agree completely, Barbara. Landing at 1000 feet (roughly 100 meters) or in the first third of the runway is the standard U.S. FAA recommendation. As I wrote back in the 21 February report, I prefaced this with “**If there is sufficient runway available....**” What is “sufficient” is heavily dependent on the airplane in question. For example, for a few years I flew a turbocharged Beech 58TC Baron, a very heavy “light” twin, much heavier than normally aspirated Barons, and with a higher final approach speed—95 knots in most cases. We based at a 3300-foot paved runway that was barely acceptable for the 58TC on a hot day with a heavy load, and without a lot of margin even light on a cool day. Exacerbating the issue was that the runway sloped fairly steeply upward (it helped to slow down landing uphill), but terrain limited climb after that as well, so although it was not a “one-way” airport and a go-around was always possible, it was important to make the go-around decision early to ensure terrain clearance.

At that airport I learned to touch down on speed, in full-flap configuration, aligned with the runway stripe, and on the runway numbers minus zero feet plus 200 feet (to the end of the first runway stripe). Anything else and I would go around. I joked with passengers that I'd give them very smooth landings anywhere else but that the home airport I needed accuracy and could not afford to go for “style points.” At that airport in that airplane, touching down 1000 feet from the threshold (just under 1/3 the total runway distance) wouldn't work. Another pilot flying that same airplane at that airport had rolled off the far end of the runway at least once, I was told.

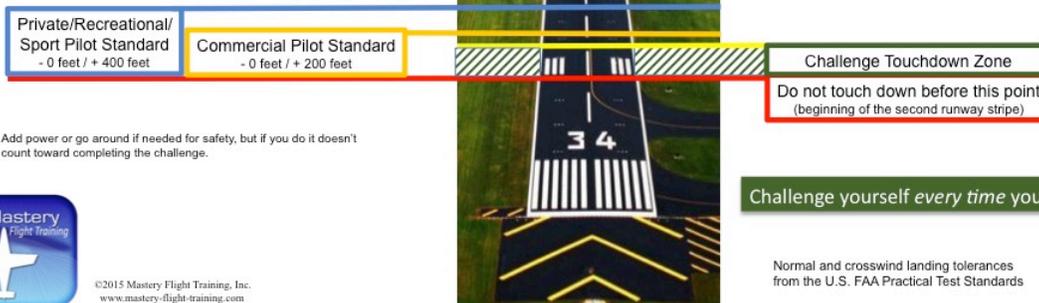
In most cases I personally aim not for the touchdown zone boxes, on IFR-marked runways, but instead on the second runway stripe. That provides a little room for an unintentional undershoot of the touchdown aim point, and provides the greatest possible landing distance from that point on. Several times I've published my “**Second Stripe Challenge**” to encourage pilots to develop and maintain a level of landing mastery that makes identifying and hitting your planned touchdown spot a routinely attained Standard Operating Procedure, to avoid runway overruns and make it easier to land at particularly short runways because the skills have already been learned and recently practices.

Take the Mastery Flight Training

Second Stripe Challenge

Make three normal landings (at least two consecutive) on the second runway stripe under these conditions:

- Stabilized approach
- POH final approach speed and configuration when crossing the runway threshold
- No power addition after extending full flaps
- Slips are permitted except as prohibited by airplane Limitations
- Initial touchdown must occur with one main wheel on each side of the runway stripe, smoothly with no side drift and without bounce, with the nosewheel remaining off the surface (tricycle gear) or in a three-point or wheel landing attitude as identified before beginning the challenge (tailwheel).



This same “second stripe” guidance could be changed for your specific aerodrome and airplane to the criteria your operation requires.

Reader Reed adds:

Next point is pilot expectations: When I used to instruct I would tell my student to expect a go around from every approach, with a possibility if everything worked perfectly of converting to a landing. Trying to get a mindset that wasn't shocked by powering up at any point in the circuit and having another go. We have a circuit height 1000 feet AGL so stable by 500 feet sounds about right for our trainers (Dr400) No approach aids, no centre line. No ATC either.

Again I agree, and so too do I teach. A go-around is a normal, expected, likely and completely acceptable part of all landings.

Whether 1000 feet/100 meters, 1/3 the total runway distance, on the second stripe, or immediately after the displaced threshold chevrons, the key in all landings is to **command the aircraft** so you **touch down where you plan**, and to **immediately go around if you are not on targets** of speed, in configuration (flaps and landing gear as appropriate), on glidepath to your planned touchdown zone, and aligned with runway centerline as you approach the runway...**making your go-around decision before you are on the ground** and in danger of a runway excursion.

See: <http://www.mastery-flight-training.com/secondstripechallenge.pdf>
<http://www.mastery-flight-training.com/20190221-flying-lessons.pdf>

Questions? Comments? Suggestions? Let us know, at mastery.flight.training@cox.net

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