FLYING LESSONS for February 23, 2012

suggested by this week's aircraft mishap reports

FLYING LESSONS uses the past week's 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 make and model airplane have little direct bearing on the possible causes of aircraft accidents, so apply these *FLYING LESSONS* to any 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.

If you wish to receive the free, expanded *FLYING LESSONS* report each week, email "subscribe" to mastery.flight.training@cox.net.

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This week's lessons:

A twin-engine airplane's pilot told reporters this week 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.

Its 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. 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 years 2000 through 2010. 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 in calendar year 2010 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 in 2010, very 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* that 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.

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 2010 may have been an anomaly; 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 in initial training and Flight Reviews.

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

Debrief: Readers write about recent *FLYING LESSONS:*

Last week *FLYING LESSONS* proposed a new paradigm for a pilot's systems education, one oriented less on the mechanical aspects of the aircraft and instead focused on systems knowledge that will help save lives and manage the workload of in-flight failures. The goal of this type of systems education is to produce a pilot who can confidently answer these questions about all the systems in the airplane he/she is flying:

1. What indications exist when the system is working normally?
2. How do I operate the system under normal circumstances?
3. What indications exist when the system is acting abnormally?
4. How do I operate the system under abnormal circumstances?
5. What indications exist when the system is under emergency conditions (i.e., imminent danger to occupants or the aircraft)?
6. How do I operate the system under emergency circumstances?
7. If a system is in an abnormal or emergency condition, what impact does that have on other aircraft systems?

Reader Fred Scott responds:

> *"... old-school engineering-level systems knowledge, of the type that has the pilot memorizing temperature limits (as opposed to green arc vs. yellow arc vs. red arc) or how many foot-pounds of force the flap motor uses to extend lift devices, or how many screws hold a particular access panel to the airframe…that World War II, military model isn't nearly as relevant as knowing what normal looks like, what abnormal looks like, and what capability you have remaining in an abnormal situation. That's the level of systems knowledge that will keep you, your passengers, and the people you fly near and over safe…."*
>
> Tom, your observation is so "Right On!". I have never cared much about whether my CHTs were 311F or 323F, but I DO CARE that they are NOT TOO HOT (a general term), that the power needles are parallel (more or less), that my Alpha [Angle of Attack indicator] in steeps and on final approach is JUST ABOUT RIGHT, etc. Except for the limits, of course ... and almost all of these have the little red radial. I probably couldn't tell you the exact number on most of the limits I use, but I do know exactly where the needles point when we are getting close. BRAVO to you! What a great point you make.

Thanks, Fred. And I appreciate everything you're doing to attack a vital concept in accident avoidance, stall avoidance. You are tireless!!

David Herberling revisits recent discussion about the dangers of hand-propping a propeller engine, and the *LESSON* that the hazards of hand-propping an airplane designed for electric start extend after the start as well, because the inability of a starting system to do its job is likely a symptom of something potentially more dangerous. David writes:

> Hand propping! I shiver at the memories of such activities during my early years of aviation. This was an almost daily activity on the flight line of the flight school I worked for as a line boy, then CFI, and charter pilot. ALL of these airplanes had electric starters. ALL of the airplanes being propped had weak batteries for some reason or another.
>
> I was trained by the Director of Operations. We never propped the airplane without a pilot inside to operate the magneto switch, mixture, and throttle. However, we never stopped to think about why the battery was weak. I remember an air taxi freight run I did with a Navajo Chieftain. When I got to my destination, the right engine would not start when I was ready to go back home. I actually contemplated propping that huge engine, but it scared the by jeebies out of me. Somebody eventually showed up who gave me a hand jumping the battery and I got that right engine started.
>
> I agree that low compression engines of low horsepower are the limit of safe hand propping. Now that I own an airplane of my own, I am very leery of the propeller. I even check the grounding of the mags on each shutdown. This policy paid off for me when I attended [an aviation convention] in Buffalo [NY]. The engine would not shut down by shutting off the mags. I knew right then that I had a bad P-lead. Prior Aviation fixed it for me before I left at the end of the convention.

> I have had enough of hand propping in my youth. I would not even consider it now.

Reader Mike Massell adds another "found flashlight" to the list of preflight inspection stories:

> Great publication. Lots of great information as always. I too have a flashlight story from years ago. It was also left behind from a mechanic and was jamming the rudder, which was also discovered on the preflight. I especially like the seven questions that you need to know about each system in your aircraft. Much better than how many screws hold on a particular panel or is it 13.2 volts or 13.5 volts that won't cause an item to work. Either way it isn't working and you need to know what the plan is and how it will affect the outcome of the flight. Thanks again for your weekly publication.

Thank you all, readers!

Let us learn from *you*…at mastery.flight.training@cox.net.

Decide. NOW!

The latest issue of NASA's *CALLBACK* (taken from real-world "NASA Reports" through the Aviation Safety Reporting System) deals with two situations that involve general aviation pilots, and one that involves an air carrier flight crew. In "the first half of the story" you will find report excerpts describing the situation up to the decision point. It is up to you to determine the possible courses of action and make a decision (preferably within the same time frame that was available to the reporter). Step up to the challenge in *CALLBACK* #385.

See http://asrs.arc.nasa.gov/docs/cb/cb_385.pdf

Share safer skies. Forward *FLYING LESSONS* to a friend.

Flying has risks. Choose wisely.

Thomas P. Turner, M.S. Aviation Safety, MCFI
2010 National FAA Safety Team Representative of the Year
2008 FAA Central Region CFI of the Year
