FLYING LESSONS for April 11, 2019

by **Thomas P. Turner**, Mastery Flight Training, Inc.
National Flight Instructor Hall of Fame inductee

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.**

FLYING LESSONS is an independent product of MASTERY FLIGHT TRAINING, INC. www.mastery-flight-training.com

Pursue ***Mastery of Flight***

This week's LESSONS:

We've had a lot of reader mail about the most recent *LESSONS*, a study of understanding and use of autopilots in general aviation airplanes. Let's go right to the Debrief.

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

Debrief: Readers write about recent *FLYING LESSONS:*

"Max"-imizing the *LESSONS*: Readers commented about last week's discussion on the general aviation *LESSONS* to be learned (or re-learned) from what we know so far about the Lion Air and Ethiopian 737 Max-8 crashes. Reader Mark Sletten writes:

> Good issue, as always. I've been following the news about the Max series MCAS closely (good grief, but you have to be careful where you get your news these days!), and I believe there is something more going on than the fact Boeing installed a system and didn't tell pilots about it. The fact is if a pilot with no knowledge of MCAS experienced MCAS activation outside of the parameters it was meant to activate (or even WITHIN those parameters) (s)he should simply see **uncommanded trim movement**. This is especially true for the Ethiopian Air crew who, according to airline officials, were briefed on preliminary information about the Lion Air crash as well as the FAA's emergency AD about it. Along with some ways to determine if it is indeed MCAS moving the stab trim, the AD tells crews to simply cutout stabilizer trim any time they experience uncommanded stab trim movement. I strongly suspect that's why Boeing chose not to develop any special procedure for unwanted MCAS activation; to any pilot who has trained in Boeing airplanes since the first KC-135s and 707s rolled off the line it should present as uncommanded trim movement. In addition, due to the time-critical nature of the required corrective action. you could make an argument that you don't want pilots wasting time trying to noodle out what is causing uncommanded stab trim movement. In the case of the

> Lion Air crew, they experienced what from their viewpoint was uncommanded stab trim movement ***21 separate times*** before losing control of the plane. How could a crew trained to recognize and respond to just such a malfunction [and] allow that to happen?
>
> I don't know whether you saw it or not, but Mac McClellan wrote a really informative piece about this over at *Air Facts Journal*, including specifics about the design philosophy which drove development and implementation of MCAS. He addressed a number of the same issues as you from a slightly different perspective.

See:
http://www.mastery-flight-training.com/20190328-flying-lessons.pdf
https://airfactsjournal.com/2019/03/can-boeing-trust-pilots/

Reader Donald Bowles adds:

> Tom, once again you've nailed it! Not only on the "envelope protection" paradigm so much in the news of late with the 737 Max accidents, but for me, on my own [Cessna] T210 autopilot, in the KFC 200 family. Your autopilot checklist is outstanding, and will now (at least synoptically) become a part of my preflight chucks. Thanks so much as always!

Reader Ron Koyich suggests an additional preflight autopilot check:

> [I] used to use these tests with the KFC-200 in my Baron, brought forward from my days working in avionics. One point needs to be adjusted in the Operational Test you've listed, though, I feel: **Flight Controls Centered** needs to include pulling back on the controls to bring the elevator off its nose-down stop. Both ailerons and elevator need to be about centered for a good test of the system. When on the ground, the engine most likely needs to be running in aircraft with attitude based systems, so the attitude source gyro is in the correct attitude.
>
> If the elevator is not pulled back from the forward stop, the elevator servo will be pushing against that stop. **The elevator needs to be somewhere in the middle of its range for a full functionality test**.

Thank you, Ron. The Supplement does not call for that but it makes sense to me. In my defense, I hold a little pressure on the elevator during my Before Takeoff checklist, and suggest the same to my students. This keeps the elevator from bouncing against its stops in the propeller slipstream, especially during the engine run-up (if you watch what the stabilizers and elevators do during run-up, and especially propeller feather checks in a Baron, you'd want to keep the elevator from bouncing against its stops then also).

Reader Bob Latham poses a philosophical question:

> I would suggest a rephrasing of the last sentence of your opening paragraph:
>
> > *Are today's pilots up to the challenge of flying commercial airliners?*
>
> Are today's commercial aircraft really better than yesterday's if a highly trained, highly experienced, highly intelligent ATP (by most objective measures) can't understand what the automation is doing? We've done pretty well for the past few decades safety-wise. **Is this progress?**

Frequent Debriefer David Rogers, professor emeritus of aeronautical engineering at the U.S. Naval Academy, writes:

> *FLYING LESSONS for March 28, 2019* is more important than most pilots will realize. Fundamentally, many if not most autopilots with envelope protection severely limit the available aircraft performance envelope. In many normal and emergency operations using the excluded parts of the aircraft performance envelope are is necessary. **Does the pilot actually know, and understand, what areas of the aircraft performance envelope are excluded?**
>
> I'll use the Garmin GFC500 autopilot as an example, mostly because I happen to have that information to hand. My use is no reflection, positive or negative, on the GFC500. First, the pilot's guide is 354 pages long. In my view, it is both a stretch to read the entire pilot's guide much less absorb and understand all the details. Furthermore, the POH/AFM [supplement] is 44 pages long. The question is: What are the limits in angle of attack, bank angle and under and over speed protection. Those appear in Section 7, the last section, on what is effectively pages 36 and 37. From those pages the angle of attack limits are:
>
> - Pitch attitude above +20° and below -15°
> - Roll attitude more than 45°

- High airspeed above 198 KIAS (228 MPH IAS)
- Low airspeed below 70 KIAS (81 MPH IAS)

The conditions under which envelope protection is engaged are:

- Pitch and Roll servos available
- Autopilot disengaged
- An above ground GPS altitude of more than 200 feet--for low airspeed mode
- Aircraft within the autopilot engagement envelope, i.e., +/-50° in pitch and +/-75° in roll

Notice that this system in in force when the autopilot is disengaged. I am not actually sure what the last one means. For example: Based on experience, a lightly loaded Bonanza does not fully stall, gear and flaps full, until in the middle 60s (mph).

There are also several warnings throughout the document about attempting to overpower the autopilot.

Reader Art Bridge reflects a sentiment I hear a lot:

> Your reflections on the 737 Max were very thoughtful--thank you. I remembered my dad back in 1968 or so: he said he got tired of flying after about 9500 hours in P-51s, P-40s, and the F-86, all airplanes requiring real pilot skill. When the squadron he commanded transitioned to the F-102, which could be flown through DataLink by a controller on the ground from takeoff to target acquisition to missile firing to landing [at] near minimums, he said, "Enough. I love to fly, not be flown." I fear the information managers in the cockpit whom we call "pilots" have, in spirit, given up their wings earned long ago when they knew how control their airplanes.

I think there is a good use for cockpit automation, but as your father said the skills required are different from those employed in years past. The new skills, however, are ***in addition to*** what pilots had to know and be able to do before automation, ***not a replacement*** for them. The key is to spend the time (and money) on teaching and learning these additional skills, and equal time in recurrent training on hand-flying and other traditional tasks as well as automation management. I understand there was a similar “old vs. new” debate when closed cockpits were introduced in commercial aircraft, surrounding the idea that a “good pilot” needed to feel the wind and hear the sound of the engine and the wires to “properly” fly a “real” airplane. Thanks, Art.

Reader Sam Dawson homes in on the primary issue:

> I find that many, if not most, CFIs do not teach student pilots anything about the autopilot until late in training, if at all. **At a minimum, I have always taught pre-solo student pilots how to engage and all the methods to disengage the autopilot.** The last thing I want is for a student pilot to experience an inadvertent engagement of the autopilot on their first solo. They should also know how it feels when the autopilot is engaged.

I was flying a Cessna 182RG east of Kansas City, Missouri, on my initial Certificated Flight Instructor (CFI) checkride. The beat-up old complex trainer was equipped with a factory-original Nav-o-Matic two axis autopilot that my Commercial and CFI rating instructor had never mentioned during training, let alone turned on or showed me how to operate. The FAA examiner (the initial Flight Instructor Practical Test had to be flown with an FAA inspector in those days, not a Designated Examiner) already told me I’d done a good job and has passed the checkride, and we were flying back into Kansas City from our practice area so I could drop him off and get my temporary certificate. That’s when he pointed at the autopilot control and asked me, “How does this thing work?”

Caught by surprise, I reached up and pushed the autopilot controller’s plastic rocker switch to ON. The airplane immediately banked sharply to the left and began to turn—I hadn’t thought to center the heading bug on the directional gyro (as we called it “in the day”), nor did I know that the autopilot was turning to the bug’s heading. To my credit I undid what I had had just done and turned off the autopilot. The examiner didn’t say a word about it, and I flew home as the nation’s newest CFI.

In retrospect going to a checkride not knowing how to operate the autopilot was my fault. But I didn't have the experience or insight I have today (that makes me wonder what I'll know in the future that I don't know now). Now, I routinely describe an autopilot as "an extremely capable, extremely stupid copilot. It will do exactly what you tell it to do and do it very well. But it's too stupid to know if you told it to do something wrong."

I strive to ensure pilots are able to **fly the autopilot and hand-fly to equal levels of proficiency** when I provide transition, recurrent and especially Instrument Proficiency Check instruction. The hard part is that (1) these days almost no two airplanes are alike, with a seemingly infinite possible combination of avionics and autopilots that "talk" to each other in different ways, and (2) new autopilot features such as envelope protection make what we know about autopilots obsolete without studying the Supplement and practice. With the prevalence of autopilots even in primary training airplanes these days you're right, Sam—this is another level of training that must be introduced and trained before a pilot should be permitted to solo, even if it is not on the list of pre-solo training requirements of 61.87(d) and (e) and the international equivalents.

See https://www.law.cornell.edu/cfr/text/14/61.87

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

Stable pilots are safe

So says the U.S. National Transportation Safety Board (NTSB) in its recent **Safety Alert: Stabilized Approaches Lead to Safe Landings**. SA-077 states:

> Failing to establish and maintain a stabilized approach, or continuing an unstabilized approach, could lead to landing too fast or too far down the runway, potentially resulting in a runway excursion, loss of control, or collision with terrain.

Using two examples of loss of control during an approach—a Lear 35A and an Epic LT—two runway overruns because of excessive speed on final—a Piper J5A and a Cessna 210—and a collision with terrain short of the runway—a Piper PA31—the Alert cautions against unstabilzied approaches and suggests these mitigations:

- Follow SOPs [Standard Operating Procedures] and industry best practices for stabilized approach criteria, including a normal glidepath, specified airspeed and descent rate, landing configuration (flaps, gear, etc.), appropriate power setting, landing checklists, and a heading that ensures only small changes are necessary to maintain runway alignment. Guidance and tips (see the "Interested in more information?" section) indicate that, in most cases, the approach should be stabilized by 1,000 ft in instrument conditions or 500 ft in visual conditions. If the approach becomes unstabilized at any time after that, go around.
- Practice go-arounds and missed approaches so that you are comfortable with the procedures when needed. Remember to establish personal minimums for all types of operations, including go-arounds and missed approaches.
- Use effective single-pilot resource management or crew resource management. A stabilized approach begins with an effective approach briefing. Ensure that you understand critical aspects of the approach, such as the minimum safe altitude, hazards, approach conditions, and missed approach procedures.
- Do not allow perceived operational pressures (for example, from air traffic controllers, passengers, etc.), continuation bias, or last-minute runway changes to influence your decision to execute a go-around; if your approach is not stabilized, go around.
- Never attempt to "save" an unstabilized approach. If the approach becomes unstabilized, conduct an immediate go-around. Remember, when two pilots are on duty, either crewmember may call for a go-around at any time.

The NTSB's first bullet point comes as close to defining a "stabilized" approach as I've seen in government or industry publications. But a stabilized approach does not mean you'll put the

airplane in the landing configuration and fly a constant airspeed from 1000 (or even 500) feet above ground all the way until the tires touch the surface, especially in a piston-powered or turboprop airplane (and not on those airline landings you enjoy, either). I address "**Stabilized Approaches in Light Airplanes**" on AVweb about a dozen years ago—an article that is cited in and linked from the NTSB Safety Alert, although the AVWeb link is not currently active (I understand AVWeb is currently migrating its website to avoid denial of service attacks). I've posted my original draft of the article here.

See:
https://www.ntsb.gov/safety/safety-alerts/Documents/SA-077.pdf
http://flash.avweb.com/news/leadingedge/leading_edge_23_stabilized_approaches-199047-1.html
http://www.mastery-flight-training.com/le-23-stabilized-approaches.pdf

Flight Instructor Professional Development

The National Association of Flight Instructors (NAFI) announces the third set of five Professional Development Program (PDP) courses. You can access the courses directly though the members-only section of the NAFI website. The next five course titles are:

Instruction Category:

The Teaching Process: Mike Thompson, CFII and retired college dean examines what the teaching process looks and feels like both for the teacher and the learner when driven by the four-part learning cycle.

Delivering an Effective Flight Review: Thomas Turner, American Bonanza Society [and Mastery Flight Training], CFII/MEI/ATP Flight Instructor Hall of Fame. Instructors learn all about the instructional process leading to the various Practical Tests, yet they receive virtually no guidance on how to conduct a Flight Review. This program presents how to "wow" your student with a tailored, effective flight review that makes the pilot even better for the experience and, hopefully, leaving eager to learn even more

Business/Communication Category:

Marketing: If You Build It, Will They Come? Aaron Dabney, MCFI and owner of Master the Tailwheel Flight School provides experience-tested advice on how to build your market thoughtfully, effectively, and without breaking your budget.

Electives Category:

Voluntary FAA Safety Reporting and Preventing Enforcement: Laura Heft, Aviation Attorney presents an overview course discussing pilot interaction with the FAA.

Aviation Weather Pilot's Rules of Thumb: Chris Dunn, Meteorologist/Pilot/Broadcaster. Learn about some basic weather rules of thumb, common misconceptions pilots have regarding weather and forecasts, a few examples of highly localized weather phenomena and why the forecast may be different from what you would expect.

Email NAFI@nafinet.org or call 866-806-6156 with questions and comments about these additions to the Professional Development Program.

See www.nafinet.org

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

Pursue *Mastery of Flight.*

Thomas P. Turner, M.S. Aviation Safety
Flight Instructor Hall of Fame 2015 Inductee
2010 National FAA Safety Team Representative of the Year
2008 FAA Central Region CFI of the Year
Three-time Master CFI