FLYING LESSONS for December 22, 2011

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.

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This week's lessons:

Two events on the same day this month combine with past events and a very recent tragedy to teach some *LESSONS* about performance, airframe ice and the use of aircraft automation.

A Beechcraft King Air F90 collided with terrain during a "low IFR" instrument approach in central Texas. According to the NTSB's preliminary report, the pilot (who survived with serious injuries) reports:

> …the airplane was experiencing an accumulation of moderate to severe mixed ice. At the time, his right windscreen was covered with ice and the left windscreen was partially covered with ice. Air Traffic Control (ATC) informed the pilot, that according to radar, he was not going to make the Final Approach Fix (FAF), for the instrument approach. Subsequently, the pilot elected to execute a missed approach. As the pilot added power, the airplane entered a 90 degree bank to the left. The pilot disconnected the autopilot and attempted to level the wings; however, the airplane then entered a 90 degree bank to the right. The pilot reported hearing the stall warning horn and said the airplane was out of control as it descended from 3,300 feet.

See www.ntsb.gov/aviationquery/brief.aspx?ev_id=20111202X62845&key=1

A Cessna Citation 560XL experienced a "pitch trim miscompare" and subsequent near loss of control while leveling off at FL410 over central Florida. In the NTSB preliminary report the crew states:

> While approaching their level off altitude of flight level 410, a "pitch trim miscompare" message illuminated in the cockpit. After accomplishing the checklist items and disconnecting the autopilot, considerable forward yoke pressure was required to maintain level flight. The crew found the manual pitch trim control wheel to be "frozen" in the forward position and unable to move it. The crew declared an emergency and diverted to MCO [Orlando, Florida]. During the descent for landing, upon reaching 8,000 feet mean sea level (MSL), the trim wheel released and the system returned to normal. The crew cancelled the emergency and landed at MCO uneventfully. After the aircraft was secured, maintenance personnel inspected flight control system. The left and right elevator trim actuators were found to be contaminated with moisture.

See www.ntsb.gov/aviationquery/brief.aspx?ev_id=20111205X75757&key=1

Every general aviation autopilot I know carries a recommendation against use of the autopilot in icing conditions. Airframe ice contamination can be masked by an autopilot until the system reaches the limit of its ability to compensate…as ice degrades the aerodynamics of the wings and tail, the trim system will trim against the degradation. But left unchecked it will eventually reach the autopilot's threshold of control; any more and the autopilot shuts off, leaving the pilot with an ice-contaminated and radically untrimmed airplane.

A condition of this kind affected seven Piper Malibus in a short period of time in the early 1990s. All broke up in flight; the pattern of FAA action shows the thought process of investigators. The PA46 fleet was originally grounded, then permitted to fly only VFR, then permitted to fly IFR but with the autopilot system disconnected, and eventually returned to full certification. The type and its derivatives have since gone on to enjoy an impressive safety record, with special pilot training protocols in place to remind pilots of the demands of flying such a high-performance airplane in high altitude flight.

Other incidents, including a [Beech Baron uncontrolled descent] from altitude over Michigan in February 2005 and the December 20th [inflight break-up of a TBM700] over New Jersey, follow a similar pattern. The investigation into the Baron crash is complete and we may never know what really happened. The TBM investigation has just begun, but already we know the pilot had reported ice before the fatal plunge, and a nearby CRJ regional jet crew had told ATC the rate of ice accumulation was so great the 50-passenger jet's deicing systems could not prevent the build-up of airframe ice [the definition of *severe* icing].

See:
www.ntsb.gov/aviationquery/brief.aspx?ev_id=20050210X00174&key=1
www.ibtimes.com/articles/270925/20111221/nj-socata-tbm-700-plane-crash-287.htm

To be fair, we have no idea what transpired in either of these events. We don't know whether either of these airplanes were being flown on autopilot at the time the fatal descent began, although use patterns in these classes of aircraft suggest it is very likely they were. But we *do* know that all GA airplanes certificated for flight in icing conditions ("known ice") and registered in the United States are affected by Airworthiness Directives prohibiting operation in severe icing conditions. We know that "known ice" certification is not valid in Supercooled Large Droplet (SLD) conditions with water droplets greater than 50 microns (0.05 millimeters) in diameter…meaning if the drop is large enough it appears as a drop on your windscreen, it's large enough to void the airplane's known ice certification and overpower its deicing equipment. And, as we've said earlier, we know that autopilot use is contraindicated in *any* icing conditions, precisely to avoid a situation where an autopilot disengages and the airplane suddenly experiences a rapid excursion from controlled flight.

See www.skybrary.aero/index.php/In-Flight_Icing

Popular Mechanics has published a transcript of the cockpit voice recording of the final moments of Air France Flight 447, which suffered pitot icing and a subsequent uncommanded autopilot disconnect, then stalled and descended for more than three minutes at over 10,000 feet per minute while the Pilot Flying was commanding full nose up on the joystick the entire time. The transcript is punctuated with observations by author Jeff Wise, whose comments (though obviously aimed at non-pilot readers) reveal a deep understanding of the issues involved. Read the article, and take special note of Wise's, well, wise conclusions:

> …the Air France 447 transcripts yield information that may ensure that no airline pilot will ever again make the same mistakes. From now on, every airline pilot will no doubt think immediately of AF447 the instant a stall-warning alarm sounds at cruise altitude. Airlines around the world will change their training programs to enforce habits that might have saved the doomed airliner: paying closer attention to the weather and to what the planes around you are doing; explicitly clarifying who's in charge when two co-pilots are alone in the cockpit; understanding the parameters of alternate law; and practicing hand-flying the airplane during all phases of flight.
>
> But the crash raises the disturbing possibility that aviation may well long be plagued by a subtler menace, one that ironically springs from the never-ending quest to make flying safer. Over the decades, airliners have been built with increasingly automated flight-control functions. These have the potential to remove a great deal of uncertainty and danger from aviation. But they also remove important information from the attention of the flight crew. While the airplane's avionics track crucial parameters such as location, speed, and heading, the human beings can pay attention to something else. But when trouble suddenly springs up and the computer decides that it can no longer cope—on a dark night, perhaps, in turbulence, far from land—the humans might find themselves with a very incomplete notion of what's going on. They'll wonder: What instruments are reliable, and which can't be trusted? What's the most pressing threat? What's going on? Unfortunately, the vast majority of pilots will have little experience in finding the answers.

AF447's Cockpit Voice Recorder (CVR) transcript is an indictment of pilot training for advanced automation. The Airbus' flight control computers employ standard "law" that, among many other things, simply *will not allow the airplane to stall* regardless of the command inputs made by the autopilot or the pilot. When the pitot system was compromised by ice, however, the computers reverted to "alternate law" rules that removed that restriction. It may very well be that the pilot was conditioned to pull fully back on the stick if the airplane was descending because, under normal conditions, this would result in maximum climb, with the computer preventing the stall that most pilots would consider inevitable under such circumstances. The Pilot Flying was probably doing exactly as he had been trained, even as the plane descended at over 10,000 feet per minute into the stormy Atlantic. I know several Airbus training captains, readers of *FLYING LESSONS*, and they suggested such an inevitable failing of human-plus-machine years before this fatal crash.

You're probably not flying an Airbus, but your airplane likely has at least some level of automation, anything from a simple electric pitch trim through a wing-leveler to a full autopilot with navigation management system. What expectations do *you* have about your cockpit automation? Will it keep you out of trouble? Will it compensate for your lack of currency or proficiency? Will it take you places, down to minimums, you'd not fly without the automation? Are you fully familiar with the automations operation, its failure modes, its insidious abnormal conditions that, if not detected, can make matters much worse? Do you know the limitations on autopilot use in icing conditions? Are you fully proficient in hand-flying your airplane in the same conditions as you take it with your autopilot? *These* are the *FLYING LESSONS* from the King Air, the Citation, the Piper Malibus, the Baron and the TBM, Air France Flight 447 and the *Popular Mechanics* article.

See www.popularmechanics.com/technology/aviation/crashes/what-really-happened-aboard-air-france-447-6611877-2#ixzz1gccakoZy

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Debrief: Readers write about recent *FLYING LESSONS:*

Reader and aviation lecturer/author Mike Busch writes:

> Mastery Flight Training, Inc. wrote:
>
>> In a twin-engine airplane, be very attuned to bank angle and rate of turn. If the bank or turn rate suddenly changes, level the wings and hold a constant heading. **It's almost impossible to use the "dead foot, dead engine" technique to identify a failed engine while turning.**
>
> 24 years of simulator-based training at FlightSafety, Simcom and Recurrent Training Center has convinced me that the "dead foot, dead engine" method doesn't work well for me even in level flight. The technique that seems to work best for me is (1) the failed engine is the one toward which the aircraft yaws, and (2) the failed engine is the one whose EGT is dropping toward zero.
>
> To me, "dead foot, dead engine" is a circular method, because to determine which foot is "dead" I first have to apply rudder to stop the yaw or center the skid indicator, so in essence I have to determine which engine failed BEFORE I do the fancy footwork upon which the "dead foot, dead engine" depends. I'm not sure who first came up with the "dead foot, dead engine" paradigm, but for me it is certainly not the best way to identify which engine failed.
>
> Parenthetically, both the "dead foot, dead engine" and the "direction of yaw" methods give the wrong answer in the event of a propeller overspeed (admittedly a rare event). If the right engine overspeeds, both methods call for the pilot to secure the left engine, which is exactly the wrong thing to do. The only method that identifies a failed engine accurately every time is falling EGT. I try never to commit to shutting down an engine without confirming that the EGT is falling on that engine. Obviously, EGT doesn't know or care about angle of bank -- it would accurately identify the failed engine even if flying inverted.

Hi, Mike: I suspect we're saying roughly the same thing. I also use a check of EGT as part of the engine failure technique, but I include it as part of the *verify* step. A trained multiengine pilot will apply rudder pressure instinctively when the airplane begins to depart from the desired flight path. Realizing there's a potential problem, he/she adjusts attitude as necessary, then launches into the procedure we're all taught: Mixtures, Props, Throttles full forward; gear up, flaps up; thence... (I like using the word "thence" <g>):

- **Identify:** dead foot dead engine
- **Verify:** EGT/TIT, then propeller to the detent, no change in handling (this is verification the pilot has the prop handle that corresponds to the identified engine)
- **Feather** (unless control, time and altitude permits troubleshooting the engine for an attempted restart).

I really do like your observations:

> (1) the failed engine is the one toward which the aircraft yaws,
>
> That's the *identification* step. I'm certain you've stepped on the opposite rudder to prevent further yaw. Then,
>
> (2) the failed engine is the one whose EGT is dropping toward zero.
>
> That's the *verification* step. A second verification is moving the prop control to the detent (again, as much to verify you have the "proper" *control handle* than to determine which engine has died).

I also teach the pilot should not let go of the prop control after this step before pulling it into feather—I've had students get this far correctly in the simulator, release the control for a moment, then reach up and pull the *other* prop control into feather.

Excellent observations, Mike! Thanks for your additions to the discussion. Have a great holiday and a prosperous new year.

Reader Karl wrote about the Queen Air stall/spin video linked from last week's report:

> Flown a lot of Queen & King Airs. The 'Popping Sound' seems like it may be in the video background and not coming from the airplane…very close to camera. [The engines] sound pretty smooth when background noise is quiet.…last moments before turn…plenty of power to accomplish a shallow pattern to a properly prepared straight in…landing configuration. Looks a lot like a very heavy low pass gone wrong!
>
> That is a problem, even normal bank angles are applied. Then consider excessive bank angles and degraded lift. [This was a] classic response to excessive wing loading (Gs) and bank…sadly so!
>
> AOA and Bank Angle got him! Failure to properly configure the airplane for its current needs contributed significantly.
>
> - huge difference between clean and an Vfe configured Queen or King Air
> - stall margins are at least 15 Knots higher than Vmc clean
> - he needed 115+ KIAS
> - an 80 degree bank angle is a challenge all up and fully operational
> - PIC failure to use 'Check List'
> - at least significant pilot error in this accident
> - by its response to pilot controls, its stall and resultant spin, it looked 'VERY HEAVY'!
>
> Lots of fuel on board – evidenced by the amount of post-impact fire on the ground
>
> Your comment of Jet-A applied is a very good direction to look [given the report of dual engine trouble, not obvious in the audio track]. If so, Pilot Error! We never allow strange flight line crews to fuel any of our aircraft, regardless of type. Had a friend killed in a [Twin Commander] 680 that was treated like a 690.
>
> Keep up the good work!

Thanks, Karl. I agree—my impression is that the engine noise appears normal as the Queen Air flies what appears to be a crosswind-to-downwind pattern entry. The popping noise on the video indeed sounds extraneous, and continues after the airplane crashed.

Unsubstantiated reports from Manila are that the pilot reported trouble with both engines shortly after takeoff and was returning for a landing when the stall/spin occurred. Regardless, it was excessive bank, coupled with a pull to resist the airplane's descent and a corresponding increase in angle of attack, that appears to have been the precipitating cause of the crash.

Your observations a bout fueling procedures are spot on, especially when flying an airplane where there may be ambiguity about the type of fuel required (a piston aircraft that looks like a similar turbine design; a turbocharged aircraft with the word "Turbo" emblazoned on a cowling, fuselage or tail, etc.). Thanks for your input. Have a great holiday and a wonderful new year!

Dave Dewhirst, whose Wichita-based Sabris Aviation specializes in transition and recurrent training in piston twins and high-performance singles, adds:

> Include as much data and video as possible. We learn from the misfortunes of others. For the Queen Air crash, you probably have the issues correctly identified. Problems with power in both engines and the popping sound indicate jet fuel. The flight path clearly shows a stall out of a turn. One engine probably would not have been producing enough power to produce a Vmc departure.
>
> It is possible to determine the actual point at which the stall occurred because the rudder can be seen going to a full right-hand deflection. All the other points you made were right on.
>
> On the rudder trim issue ["rudder reversal" when reducing power to flare after trimming for single-engine flight in a twinon one engine], we teach not to re-trim the rudder for engine-out operations in any flight situation except cruise. Using trim to relieve rudder pressure for one-engine operation on approaches or landing pattern is a bad idea because at the moment of touchdown the airplane is out of trim in the opposite direction [i.e., "rudder reversal"]. The situation is made worse because the feathered [propeller] will have less drag than the operating engine and the airplane will actually need rudder movement in the direction of the dead engine.
>
> We teach to look at it as [the same effect as] a mild crosswind at touchdown, and use rudder to maintain runway alignment. If the pilot's leg gets tired when holding all that rudder pressure for several minutes, we teach him to put both feet on the same rudder pedal until that extra pressure is no longer needed. That way, when breaking out at 200 & 1/2, the airplane is pretty much in trim.
>
> Good job as always.

Excellent input as always, Dave, especially your observations on rudder trim.

Readers, tell us what you think, at mastery.flight.training@cox.net.

We've been discussing the Number 1 cause of fatal general aviation events, according to the U.S. Federal Aviation Administration: **Loss of Control during Maneuvering Flight**. In early January we'll have a wrap-up of this cause, followed by a synopsis of comments and mitigation techniques for the full list of Top 10 Causes of Fatal General Aviation Accidents. Hopefully this year-long exercise will have inspired instructors to present ways of avoiding the most common ways we die (and kill) in light airplanes, and all pilots will recognize the patterns that lead to fatal GA wrecks and changed their flying behaviors accordingly.

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
