FLYING LESSONS for August 15, 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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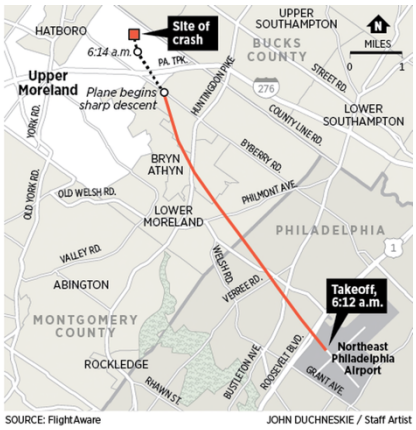
This week's LESSONS:

Last week three aboard a Beech Bonanza died three minutes after taking off into Instrument Meteorological Conditions (IMC) right at local dawn. Weather was reportedly 800 overcast, visibility five miles in haze, which would have made it very dark below the clouds. The three aboard—three members of a family of four—perished.



According to local news accounts, the airplane flew an approximately straight line from takeoff to flight's end. Witness reports (which are notoriously suspect) and the airplane's speed suggest the engine was running, and first responders report a strong fuel odor on site despite the lack of post-crash fire. The Bonanza impacted at a high speed and high forward speed that is inconsistent with either a stall or spiral—suggesting something other than a "traditional" Loss of Control – Inflight scenario.

See https://www.inquirer.com/news/pennsylvania/plane-crash-montgomery-county-jasvir-divya-khurana-ntsb-20190809.html

There is only very preliminary information from the FAA as of this writing, and no preliminary report yet from the NTSB. Any definitive information about this tragic event will have to wait for the investigative results, if we learn any useful data even then.

Learning of this crash, I was immediately reminded of another tragic early morning departure under similar, though somewhat worse, circumstances. I wrote about it about a year and a half ago in *Aviation Safety*, portions of which I'll repeat below. At the time my comments were made on the basis of NTSB preliminary report information. The NTSB's final Probable Cause report has since been issued—I've replaced preliminary report information with final data below—but the remainder of my commentary is unchanged by the final report with the exception of some parenthetical statements I made about currency in simulators that has been superseded by November 2018 changes in the U.S. Federal Air Regulations.

See:
http://www.aviationsafetymagazine.com
https://app.ntsb.gov/pdfgenerator/ReportGeneratorFile.ashx?EventID=20171224X03602&AKey=1&RType=Final&IType=FA

Although the Christmas Eve 2017 Cessna 340A crash occurred in even worse weather conditions than the Bonanza, and of course we don't know anything official about the North Philadelphia event, these *LESSONS* apply to any low-visibility, early morning takeoff.

In an event that received significant publicity in and out of aviation circles, a family of five was killed during an attempted predawn, IMC departure. The NTSB report tells us:

> The instrument-rated private pilot and four passengers boarded the [Cessna 340A] multiengine airplane inside a hangar. The pilot then requested that the airplane be towed from the hangar to the ramp, since he did not want to hit anything on the ramp while taxiing in the dense fog. Witnesses heard the pre-takeoff engine run-up toward the end of the runway but could not see the airplane as it departed; the engines sounded normal during the run-up and takeoff. A witness video recorded the takeoff but the airplane was not visible due to the dense fog. During the takeoff roll the airplane's tires chirped, which is consistent with the wheels touching down on the runway with a side load. The video ended before the accident occurred. The witnesses stated that the takeoff continued and then they heard the airplane impact the ground and saw an explosion. The weather conditions at the time of the accident included visibility less than 1/4 mile in fog and an overcast ceiling at 300 ft above ground level. The airplane's weight at the time of the accident was about 105 lbs over the maximum takeoff weight, which exceeded the center of gravity moment envelope. The excess weight would have likely extended the takeoff roll, decreased the climb rate, and increased the amount of elevator pressure required to lift off of the runway [i.e., loaded forward of the forward CG limit—TT]. Based on the evidence it's likely that when the airplane entered instrument meteorological conditions the pilot experienced spatial disorientation, which resulted in a loss of control and descent into terrain. The National Transportation Safety Board determines the probable cause(s) of this accident to be: **The pilot's loss of control due to spatial disorientation during takeoff in instrument meteorological conditions**.

The awful circumstances of this crash remind us of the extra planning and skill needed for a departure into low IMC, day or night—even if everything is going right.

Do we need another column?
What does it take to maintain instrument currency? Instrument training, evaluation, practice and recency of experience is measured primarily in getting the airplane down from altitude. 14 CFR 61.57, Recency of Experience, tells us if we remain current in an aircraft the only specific things we need to have recent experience in are: Six instrument approaches; Holding procedures and tasks; and Intercepting and tracking courses through the use of navigational electronic systems. The Airman Certification Standards (ACS) and requirements of an Instrument Proficiency Check (IPC) are very similar: there is ***no specific requirement to demonstrate proficiency in making low-visibility or IMC takeoffs***.

Instrument training and evaluation is weighted heavily toward arrival and approach procedures. We log the number and type of approaches we fly and consider precisely flying an arrival procedure the ultimate test of our IFR ability—even if we let an autopilot do the job for us. ***Way*** down on the training/evaluation priorities list, if it's there at all, is **recency of experience and proficiency in flying departure procedures**.

Low-visibility takeoffs are lost in practice. We probably don't spend much time at all training and reviewing them, we're not evaluated on our ability to perform them, and we don't track our proficiency in low-vis departures by logging the number we fly or practice. **Maybe we need another column in our logbooks to record the number and date of actual or simulated low IMC departures.** Perhaps there should be a requirement to have some recent experience in that column before we can fly IFR, or at least take off into IMC. But we don't, and there isn't. So when called upon to make an IFR or even a marginal VFR night takeoff, we frequently have no recent experience in flying the procedure.

Unseen hazards
Logically, if a pilot is IFR current and skilled, taking off into the murk (day or night) shouldn't be any riskier than making an instrument approach. There are other hazards besides IMC itself, however, that pilots face when making a departure in IMC—threats that are greatly magnified when the pilot's visibility is restricted. Let's look at four such hazards:

***Getting up to speed*:** You might be tired and a little worn out by the time you begin an instrument approach at the end of a flight. But even if you are, you have plenty of time to get "into the groove" and prepared for a low visibility arrival. You have no way of knowing for certain you're up to speed for an IMC *departure*, however, until you're actually in the air—finding out whether you're at the top of your game just as you enter a high-workload condition with the airplane fairly slow and at a high angle of attack, all while close to the ground. **There isn't any time to catch up** before a low-visibility takeoff, to get the feel for the airplane or to detect and correct for any missed briefing or checklist items.

***Airplane checks and performance*:** The airplane may meet all airworthiness requirements and pass all preflight and Before Takeoff checks. But it is only really put to the test when you take off. If you've missed an item (failed to set trim for takeoff, didn't put the right frequency in standby for Departure Control, etc.), you'll probably find it early in flight. If there is anything that isn't quite right (or worse) with the airplane or engine itself that is not immediately obvious during the run-up, now's the time it may manifest itself in decreased or impaired performance.

***Fatigue*:** The NTSB has repeatedly included operator fatigue in its Most Wanted List for reducing fatal transportation accidents. Fatigue can certainly be a factor in low IMC departures—especially if the pilot awoke several hours before dawn to launch in the dark. The role of pilot fatigue in general aviation mishaps is a big unknown. NTSB simply doesn't have the time or resources to investigate the recent sleep history of accident pilots, and even if they tried there may be little data to go on. Being tired and taking off into a 300-foot ceiling with fog so thick you don't want to taxi in it may, however, indicate fatigue-impaired judgment. Evaluating your fatigue state is a factor to consider in all IMC departures.

***False climb illusion*:** Compounding the challenge of low-visibility and sometimes high-workload departures is a physiological hazard known as the "somatogravic" or "false climb" illusion. Somatogravic illusion is the result of fluid moving in a pilot's inner ear when an aircraft accelerates. Pilots sense this motion as a pitching movement upward—a false sensation of climb. Without a good natural horizon, and if inattentive to or distracted from the instruments, this sensation can cause a pilot to push forward on the yoke to "recover" from the false climb. He/she forces the airplane downward because they *think* it is going up too steeply or too rapidly.

See https://www.boldmethod.com/learn-to-fly/aeromedical-factors/the-somatogravic-illusion-causes-accidents-how-to-prevent-it/

A common personal minimum is to require weather to be at least that airport's circling minimums in order to take off. Most of the time this recommendation is used in the context of being able to return to the departure airport in the event of an abnormal or emergency condition shortly after takeoff. This self-imposed limitation, however, can also provide a greater margin of time to manage the risks of personal and airplane spool-up, fatigue management and the false climb illusion, before entering the clouds.

Departure control

Regardless of a pilot's experience, here are some ways to maintain control during a low-visibility departure:

- **Checks and flows.** Use checklists like you were taking a type rating checkride, *every time* you fly. Don't take shortcuts—printed checklists and confirming visual checks are designed specifically to protect you when you are a little off your game and more likely to miss something. Fly like you train, and train like you fly.
- **Organize before you fly.** Get everything set before you take off. Don't think "I'll program the GPS or call up the en route chart on my mobile device once I'm in the air." Don't take the runway for departure until all the set-up work is done.
- **Brief the departure.** Review the departure procedure and clearance with the same scrutiny you apply to an IFR approach. Brief yourself on the *altitude*, *heading* and expected *route*. If you're departing on vectors, know the approximate heading to your first expected fix, so when you're cleared "direct to" or "own navigation" the required turn is not a surprise. If you're following a SID or an Obstacle Departure Procedure, brief it and have it loaded into your nav system before you climb, as well as you know an ILS approach before you'd descend on the glideslope.

- **Fly what you briefed.** "Plan your flight and fly your plan" works. Your plans might change. But vectors or updated clearances should be the only changes you need to process mentally—be prepared for everything else.
- **Sterilize the cockpit.** Focus solely on the immediate task when making a low-visibility departure. Don't worry about extraneous details until you are trimmed in cruise climb and well away from the airport. There's a case to be made for hand-flying the departure all the way to altitude—this keeps you more focused on the vital, immediate tasks of managing altitude, airspeed, heading and navigation in the initial phases of a low-visibility departure.

Zero-Zero Takeoff

An old-school staple of instrument training is the simulated zero-zero (zero visibility, zero ceiling) takeoff. Line up precisely on the centerline of the runway, don the view limiting device (with your trusty CFII by your side, of course), ease in the throttle, and keep the heading indicator locked on runway heading as you accelerate to liftoff speed and climb out. I remember doing this during my initial instrument rating training 31(!) years ago; my instructor had me do this on an IPC I flew late last year. It's a great confidence builder, and in some ways is easier than making the transition from visual to instrument flight in the very early stages of departure.

Trouble is, this task or technique is not required by the Instrument Proficiency Check requirements, or even in the Airman Certification Standards on which the IPC is based. Although "departure procedures (DPs) and associated climb gradients" is a Knowledge requirement of Area V Task B: Departure, En route and Arrival Procedures on the Instrument pilot ACS, **there is no specific requirement to fly an instrument departure, let alone a low IFR takeoff, on the IFR Practical Test or an Instrument Proficiency Check.** Individual examiners and CFIIs might include a simulated low IFR or even a zero-zero takeoff on a flight check, but **it is not required for a pilot to *ever* demonstrate this technique**.

The FAA's *Instrument Flying Handbook* tell us:

> Another valuable maneuver to learn is the instrument takeoff. This maneuver requires the pilot to maneuver the aircraft during the takeoff roll by reference to flight instruments alone with no outside visual reference. With practice, this maneuver becomes as routine as a standard rate turn. The reason behind practicing instrument takeoffs is to reduce the disorientation that can occur during the transitional phase of quickly moving the eyes from the outside references inside to the flight instruments.

The *IFH* offers techniques for instrument takeoffs both with traditional instrumentation and using synthetic vision on a Primary Flight Display. Ask your CFII to include simulated zero-zero takeoffs in your next recurrent training or IPC to be better prepared for takeoff off into IMC.

Check it out

As an instrument instructor, I find pilots frequently become lax about the routine verification of instrument operation. If upon reflection you find you're among them, remember these vital IFR checks:

- Flight instrument checks: Although the specific requirement to check flight instrument operation prior to IFR flight is not in the regulations, the process is described in the *Instrument Flying Handbook* and the Instrument Pilot *Airman Certification Standards:*

  > Perform preflight inspection by following the checklist appropriate to the aircraft and determine that the aircraft is in a condition for safe instrument flight, to include: communications equipment, navigation equipment, and databases appropriate to the aircraft flown, magnetic compass, heading indicator, attitude indicator, altimeter, turn - and - slip indicator/turn coordinator, vertical speed indicator, airspeed indicator, clock, power source for gyro instruments, pitot heat, electronic flight instrument display, traffic awareness/warning/avoidance system, terrain awareness/warning/alert system, FMS, and autopilot.

- VOR operational check: 91.171 details the operational check of VOR equipment, required within the previous 30 days of an IFR flight if VOR navigation is to be used.

It's especially important to known your instruments are working properly if you make a low-visibility takeoff. Before engine start, confirm the 30-day VOR check is current, and if the airplane has a standard the magnetic compass, ensure it is full of fluid. After engine start, check:

- The attitude indicator erects, and if the system is air driven, the vacuum or pressure output is correct;
- The heading indicator erects, and if it's slaved, it aligns to known heading and agrees with the magnetic compass (subject to the compass correction card); and
- With the current altimeter setting dialed in, the altimeter reads ±75 feet of the published field elevation.

While making turns during taxi to the runway, confirm:

- The magnetic compass spins freely and indicates known headings;
- The airspeed indication makes sense—it reads zero unless you're pointed into a surface wind that's strong enough to register on the gauge;
- The attitude indicator remains steady, banking no more than 5 degrees in turns (most will remain completely upright);
- The turn coordinator airplane symbol or turn-and-bank needle indicates a turn in the proper direction, and the slip/skid ball goes opposite the turn; and
- The heading indicator moves freely and indicates known headings.

When you align with the runway for takeoff, ensure the heading indicator agrees with the charted runway heading.

If your flight instruments are driven by an Attitude/Heading Reference System (AHRS), check that all the Primary Flight Display (PFD) indications meet these same preflight criteria. Glass or steam gauge, if any instrument does *not* perform as expected, taxi it back to the ramp and have the instruments checked before IFR flight.

Takeoff target
Does your airplane have a flight director with a Go-Around (GA) or Go-Around/Missed Approach (GA/MA) button? Most GA or GA/MA buttons, when pressed, disengage the autopilot (if it's on), and move the flight director command bars to a wings-level, seven to 10 degree nose up attitude—close to optimal climb attitude for many airplanes. Why not ***use this to give you an attitude target for a low-visibility takeoff***? Line up precisely on the runway, click the GA/MA button and confirm the flight director command bars rise up. When you raise the nose for takeoff, pitch to put the airplane symbol in the notch of the command bars for a precise, wings-level climb attitude until you have enough altitude to turn on course.

All this sounds quite remedial, but my experience is that a lot of instrument pilots don't routinely make these IFR instrument checks. If you're taking off into low clouds or reduced visibility, you need to be able to trust your instruments.

Our training, evaluation and rules for instrument currency all revolve around getting *down* from altitude. But taking off into murky skies shouldn't result in a perfectly functioning aircraft impacting terrain. **Plan and execute your low-visibility departures with the same care and planning you apply to a low-minimums approach**, with the added knowledge that you never know for certain how up-to-speed you and the airplane are until you're already committed to flight.

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

Debrief: Readers write about recent *FLYING LESSONS:*

Several readers responded to last week's discussion of steep turns I the traffic pattern, especially a reader's comment about sailplanes. Reader (and my high school friend) Paul Siegmund writes:

> Mandatory steep pattern turns? Uhh, no. I remember that CAP summer, Tom. I was a year younger thus slotted into gliders while you and the big kids got to make noise. First, I recall all our instructors being efficiency badgers about **correct and alert rudder use at all times**. How to precisely skid in the moments when coordinated flight was inappropriate, and how to nail zero beta at all other times. **There was no training to hedge against improper rudder use. There was always and only the imperative to get the rudder right.** All live glider pilots are good with, and unafraid of, rudder pedals in any aircraft; even at knowing when not to use them.
>
> All that said—gliders are unstable in roll. By the way complete roll stability usually is a FBW [Fly by Wire] function, while the rest of the cable and rod world has some birds that are less unstable than others, but they all want to spiral. Gliders more so than most, but they rarely land in the conditions that invite developing spirals to turn badly because, you know, day VFR and all that. But clear weather doesn't mean somebody's instructor suggested making every landing an air show. Relax. Gliders are slow, turn rates are high.

Reader Richard Depinay adds:

> I was surprised to read about a debrief note in your last *FLYING LESSONS*…that glider pilots are told to keep a bank angle of 45 degrees of bank ideally, during a traffic pattern. I was a CFIA/CFIG in France, and now in the US. In both countries, I never heard of doing it this way. It actually would be interesting to know from which soaring center [the reader who commented] flies, as this is not a standard in the glider world, nor any requirements. Gliders have such a glide ratio, that without airbrakes the pattern would be flown wide and large like an airliner. Obviously, this would be impossible to achieve safely, as you can't get back some energy with a throttle! As a result, patterns are flown ¼ to ½ mile from the runway. (It would look like what you would do if your engine failed in a single engine powered airplane). You are constantly judging your approach angle while monitoring airspeed. Medium turns are used with no requirements for them to be steep. (This would require some excess energy, anyway) Spoilers/dive brakes are used to dissipate excess altitude.
>
> Strong X-winds, tailwinds, or high sink rates that are encountered in the traffic pattern will require the pilot to modify the path as needed. Abeam the touchdown point, the altitude is usually around 500-600 feet AGL. The turn to base leg is started at about 45 degrees, but is constantly adjusted to keep the point of intended touchdown area within easy gliding distance. Again, nothing steep here is required.

Thank you, Richard and Paul. No offense to the reader who wrote about steep turns in sailplanes last week—you raised a question and others had responded with their experience. We all learn as a result…and if your technique consistently works for you, and you carefully avoid stalls and spirals, then there's nothing wrong with it from a regulatory standpoint. Just be very careful!

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

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