FLYING LESSONS for September 27, 2018

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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.**

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This week's LESSONS:

Australia's Air Transport Safety Bureau (ATSB) reports:

> On the morning of 21 February 2017, the pilot of a Beechcraft B200 King Air aircraft, registered VH-ZCR was conducting a charter passenger flight from Essendon Airport, Victoria to King Island, Tasmania with four passengers on board.
>
> The aircraft's take-off roll was longer than expected and a yaw to the left was observed after rotation. The aircraft's track began diverging to the left of the runway centreline before rotation and the divergence increased as the flight progressed. The aircraft entered a shallow climb followed by a substantial left sideslip with minimal roll. The aircraft then began to descend and the pilot transmitted a Mayday call. The aircraft subsequently collided with a building in the Bulla Road Precinct Retail Outlet Centre of Essendon Airport.
>
> The aircraft was destroyed by the impact and post-impact fire, and all on board were fatally injured. The building was severely damaged and two people on the ground received minor injuries.

At the time shortly after it happened, this Australian crash was frequently compared with a somewhat similar King Air crash that occurred on October 30, 2014 at Wichita, Kansas. The NTSB's final, "Probable Cause" report in that accident concluded that:

> The pilot's failure to maintain lateral control of the airplane after a reduction in left engine power and his application of inappropriate rudder input. Contributing to the accident was the pilot's failure to follow the emergency procedures for an engine failure during takeoff. Also contributing to the accident was the left engine power reduction for reasons that could not be determined because a postaccident examination did not reveal any anomalies that would have precluded normal operation and thermal damage precluded a complete examination.

See https://www.ntsb.gov/_layouts/ntsb.aviation/brief.aspx?ev_id=20141030X24112&key=1

A superficial look at the early data from the Australian crash makes it easy to conclude this was another case of engine failure on takeoff and loss of directional control that led to a departure from the planned flight path and ultimately a collision with obstacles. The early conclusion: better training on engine failures during and immediately after takeoff in multiengine airplanes, and attention to a skeptical mindset that prompts pilots to detect flight path deviations early, correct them if able, and abort the takeoff immediately if corrections do not have an equally immediate, positive effect. These were the lessons of the Wichita crash, and it seemed natural to apply them to the Essendon event because, well, it was another King Air and another left turn to collision right after takeoff.

There were clues in the original Australian report, however, that might suggest something different had happened. Most notably, ATSB noted that airplane was in a "substantial left sideslip ***with minimal roll*** [emphasis added]." An engine failure usually includes both a yawing (slip or skid) and a roll component. Admittedly, the Wichita King Air impacted a simulator training facility in nearly wings-level flight too, but witnesses had reported seeing the airplane bank (roll), and the pilot appears to have been beginning to recover in the American crash. ATSB reported the Victoria accident airplane had not begun to roll, only that it yawed.

As it turns out, the Essendon King Air crash was caused by something completely different. ATSB published its final report this week, a report that results in other lessons that apply to *all* of use, no matter what we fly. ATSB writes:

> …the pilot did not detect that the aircraft's rudder trim was in the full nose-left position prior to take-off. The position of the rudder trim resulted in a loss of directional control and had a significant impact on the aircraft's climb performance in the latter part of the flight.

There were several other factors involved in the accident flight, but ATSB does not consider them to have has a significant effect on the outcome.

See http://www.atsb.gov.au/publications/investigation_reports/2017/aair/ao-2017-024/

ATSB's conclusions are summed up in its Safety Message contained within the final report, which states (again, with my emphasis added):

> **Cockpit checklists are an essential tool** for overcoming limitations with pilot memory, and ensuring that action items are completed in sequence and without omission. The improper or non-use of checklists has been cited as a factor in some aircraft accidents. Research has shown that this may occur for varying reasons and that **experienced pilots are not immune to checklist errors**. This accident highlights the critical importance of appropriately actioning and completing checklists.

This was not an engine failure during takeoff, as many originally assumed. It was simply the result of forgetting to set the trim for takeoff. This can happen in light, personal airplanes just as readily as it did in this heavy King Air. ***Checking the trim position(s) is a vital part of every Before Takeoff checklist***. Trim, after all, drives the position of primary flight controls, and the faster you're going the more effective trim becomes in moving control surfaces (because greater air flow increases trim effectiveness).

The only time I've been deposed turns out to be the case of improperly set trim as well. A turbocharged Beech Bonanza was departing when (as often happens in piston Beechcraft) its forward cabin door popped open just as the airplane lifted off. Training to avoid and, if avoidance fails, recover from this type of event is one of what I call a "rite of passage" for the transitioning Beech pilot. I was deposed as a potential expert witness because *FLYING*Magazine columnist Nigel Moll had attended my Bonanza class as part of his article on the 25th anniversary of introduction of the Model 36 (ok, it's been a while). He quoted me on several things in his article, including the issue of door-open events. Suddenly I was "the expert" on such things.

We teach pilots to properly secure the door before flight—to do it themselves, not let a passenger close the door. We demonstrate that if the door opens at liftoff, when it most commonly occurs, that aerodynamics prevent closing the door in flight. We practice flying the airplane with only slightly degraded performance back to a landing. Once back on the ground, secure the door and take off again.

The pilot flew the pattern, landed and closed the door. Yes, he did everything right…*except* he did not re-set the elevator trim before his second takeoff. A turbocharger-equipped Bonanza tends to be very nose-heavy, especially with full fuel and only the front seats occupied (the pilot was alone in the aircraft). The normal takeoff trim position in this model of Beechcraft is from three to six units "up" on a calibrated trim indicator. Trim off the pressures on final approach in an airplane with this loaded condition, however, and the elevator trim will be at 19 to 21 units "up" or more when the wheels touch the runway.

With power application at the beginning of his next takeoff, and with the trim set in the landing position (as was confirmed by investigators), and the airplane will pitch up dramatically. That's what apparently happened, because the Bonanza stalled right after liftoff, killing the pilot. Like the Australian King Air, all because the trim was not properly set.

How can we protect ourselves, our passengers and those beneath our flight path from the effects of improperly set trim for takeoff?

- **Use your checklists.** Confirm during your Before Takeoff checks that all moveable trim tabs are in their correct takeoff position.
- **Confirm trim position before *every* takeoff,** even if it's not the first takeoff of a flight. I use a quick mnemonic for a Final Items check, "FLLATTSS", before every takeoff. It includes:
    - **F**laps set
    - Cowl **F**laps open
    - **L**ights (strobes, landing lights)
    - **L**atches (doors and windows secure)
    - **A**vionics set
    - **T**rim(s) set for takeoff
    - **T**ime recorded (for fuel management and IFR "lost comm" procedures)
    - **S**witches (pitot heat on, air conditioning off, etc. as required)
    - **S**eat belts (confirm passengers are still secure)
- **Abort takeoff at the *first* indication** of a difficulty or inability to maintain directional control. As a guide(line), **keep the runway centerline between the main wheels**. If the airplane drifts enough that one of the mains touches the centerline, abort the takeoff. It might be a wind issue, it might be power loss in a twin, it may be a trim problem…you don't know the cause yet, but you know the effect. Stop your takeoff and figure it out.

Often it's the little things that set off a chain reaction that results in a mishap. It's easy to forget the little things when you're busy, or distracted, or in a rush—and suddenly they are not so little any more.

That's why we have checklists—one last way to catch those little things like trim before they have a *big* effect on the success of a flight. No matter what you fly, complete a Before Takeoff Final Items checklist appropriate to your aircraft.

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

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Debrief: Readers write about recent *FLYING LESSONS:*

Reader and well-known flight instructor Zdravko Podolski writes about last week's *LESSONS* on airplane weight, center of gravity, stability and control:

> One minor correction to an otherwise excellent *FLYING LESSON*. **For any given weight, an aft loaded conventional airplane will actually fly at a *lower* angle of attack [than] if it was forward loaded.** One of the reasons why the Bonanza was so efficient... Happy to go into it in more depth if you wish, but if in doubt just remember what the horizontal stabilizer does.
>
> Keep up the good work.

That's actually a pretty major correction, Zdravko, and I'm sorry let that slip past me. You're correct: *if the pilot maintains a constant vertical speed* an aft-loaded airplane will fly at a lower angle of attack. To visualize this, think of an airplane maintaining altitude while loaded at the rear of its envelope. It will tend to pitch upward compared to a more fully forward loaded airplane. Because it pitches upward, it tends to climb. Consequently, the pilot must trim the nose further down—to a lower angle of attack—to maintain altitude.

What I *meant* to emphasize is that the aft-CG airplane will tend to pitch up, increasing its angle of attack, unless the pilot provides more force that normal for the vertical speed he/she desires. Apply the "usual" pressure necessary to flare for landing in an airplane loaded farther aft that you're used to, and the angle of attack will increase more than you'd normally expect. The lower breakout forces and reduced pitch stability (both described in last week's *LESSONS*) make this an even greater hazard for the pilot not used to flight at the aft limits of the loading envelope. Thanks for helping me clarify and emphasize this point, Zdravko.

See http://www.mastery-flight-training.com/20180920-flying-lessons.pdf

Reader Alan David adds:

> Another thing to consider is that most pilots never have anyone but their instructor in the airplane with them until after they complete their training. Since it is likely that they will take people for "rides" shortly after they become certificated, **it is a good idea to have at least one or two training flights when there are "riders/passengers" in the airplane** - like another student or instructor, or both, to add the rearward dimension so the student can SEE it.
>
> I was on a checkout ride for a new instructor once and he made three great landings in a row at three airports we used. He was quite surprised by those landings, as he had not experienced them like that before. I suggested that the reason might be the "dead weight" in the back seat. He had never even considered that! (172s do land better/easier with a little weight in the back!)

C172s aren't the only airplanes that can benefit from a little rearward loading for landing, Alan. You're right—whether with passengers or ballast to simulate them, this is a good addition to transition training and even as you say to primary flight instruction, a real-world scenario a pilot should experience first under controlled conditions with an instructor on board. Thanks, Alan.

Reader Paul Safran noted that the link in last week's *FLYING LESSONS* direct email was broken. The link on the Mastery Flight Training website was correct, but I apologize for using the wrong report date in the email blast's web link. Here's the correct link to last week's report. As always, if you have trouble finding the pdf version please check www.mastery-flight-training.com to see if you can find it there. Thanks for catching this, Paul!

See http://www.mastery-flight-training.com/20180920-flying-lessons.pdf

Instructor Dab Bindl continues:

> This article includes a lot of very good, valuable stuff, but we need to discuss one key line. In my opinion, in the aft CG discussion, "fly at a higher angle of attack" is NOT a valid byproduct of CG. The AOA is managed by the elevator input, to compensate for a change in the location of the CG. The AOA is managed by an elevator input, to compensate for any change in the air speed. Assuming, in each case, that we want to maintain a constant altitude, during our flight experience.

Thanks, Dan. I *think* I covered that above. But I'll also add that AoA is controlled by the elevator both based on its position, the elevator's effectiveness at any one time, and the rate at which the pilot provides elevator input…in other words, the elevator input **plus** any change in G-load that results from control effectiveness and rate of pitch change. Further, AoA is dependent on power—more power means a lower angle of attack given all other conditions are equal. That's why we can fly an airplane at power at a pitch attitude that would result in a stall without power—more power means a lower angle of attack.

Sometimes I think this discussion can get so deep that it's like "seeing music" or "hearing color"—it takes a savant to fully visualize angle of attack. I guess I need to get back into my notes on *Stick and Rudder*…which I'll try to do in the coming weeks. Thanks, Dan!

See https://www.amazon.com/Stick-Rudder-Explanation-Art-Flying/dp/0070362408

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

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