FLYING LESSONS for August 2, 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.

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This week's lessons:

Failure to attain climb during takeoff, and collision with obstacles or terrain off the end of the airport, may usually be attributed to one of these contributing factors:

- High density altitude
- Power development
- Airplane weight
- Airplane center of gravity location
- Trim setting
- Control movement and authority

Let's look briefly at each.

High density altitude occurs any time the air is above standard temperature (15°C at sea level, decreasing by 2°C for each 1000 feet above sea level) and/or the air pressure is below standard pressure (29.92 inches Hg/1013.2 hectopascal, decreasing approximately one inch Hg or 34 hectopascals for each 1000 foot increase in altitude in the lower atmosphere). Density altitude is pressure altitude corrected for nonstandard temperature.

Density altitude is the vertical distance above sea level in the standard atmosphere at which a given density is to be found. The density of air has significant effects on the aircraft's performance because as air becomes less dense, it reduces:

- Power, because the engine takes in less air.
- Thrust, because a propeller is less efficient in thin air.
- Lift, because the thin air exerts less force on the airfoils.

"High" density altitude is a relative term; anything higher than standard temperature or lower than standard pressure is cause for considering the effect conditions have on airplane performance.

An airplane "pulled" off the ground at too low an airspeed may rise into ground effect but not be able to climb further. The pilot finds him/herself in the dire position of having to lower the nose to increase airflow and therefore lift—in a position where there's no altitude to lose. A common high density altitude scenario is for the airplane to lift into ground effect and continue onward until it collides with an object…the pilot unwilling to pull power and make the airplane settle onto the ground under control at a point of the pilot's choosing.

You don't need to be in the mountains to be affected by density altitude. During the first day of AirVenture 2012, for example, the afternoon surface temperature at Oshkosh, Wisconsin was 102°F. Density altitude at the 808-foot field elevation airport was over 3900 feet

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under air pressure conditions at the time—reducing an airplane's optimal engine performance by more than 10% unless the engine is turbocharged.

Power development is closely related to density altitude. Even turbocharged engines lose performance in the thin air of high density altitude; compressing induction air more to make up for the natural atmosphere's loss increases heat, reducing power; propeller airfoils have less air to bite, turning a given amount of engine power into less thrust than at lower elevations.

Airplane weight will naturally affect takeoff and initial climb performance. For a given amount of engine power, a heavier airplane's performance will suffer.

Further, the center of gravity location plays a significant part. Forward CGs increase takeoff performance and reduce initial climb rate. They cause the airplane to fly at a higher angle of attack for a given airspeed, and require greater elevator deflection for a given pitch attitude—which increases drag, reducing performance further.

Trim setting, too, helps determine if the pilot can smoothly attain an initial climb attitude. Set the trim wrong and performance may be markedly reduced.

And of course failure to remove a control gust lock will prevent control movement, a contributor to far too many crashes on takeoff from failure to attain a climb.

To make a safe takeoff:

- Account for the effects of density altitude.
- Load the airplane within the approved weight and balance envelope. Avoid excessively forward center of gravity loadings in high density altitude conditions.
- Use a Before Takeoff checklist *every time*—including a Controls—FREE AND CORRECT check just before taking the active runway for departure, and confirmation of the trim setting.
- Maximize engine power by leaning for Best Power for takeoff, amended as needed per the airplane's approved manual.
- Monitor power during the takeoff roll. Abort the takeoff if you do not attain expected power levels.
- Accelerate to the normal indicated liftoff speed before allowing the airplane to become airborne. Maintain a Vy pitch attitude for initial climb unless conditions require otherwise. Avoid high angles of attack.

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

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Debrief: Readers write about recent *FLYING LESSONS:*

A recent *LESSON* discussed an off-airport landing, well-executed, that didn't need to happen at all…it was the result of fuel starvation and the pilot apparently did not follow the emergency

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procedure to switch to another tank to restart the engine. Reader Doug Hershkowitz sends this follow-up:

> So, he landed off field because he had a gas cap with a bad gasket that was leaking fluid. Then he neglected to change his tank when he ran out of gas and so he could not start his engine. This is a classic case of a chain of events that usually leads to a much worse outcome. He was just lucky. I have a problem giving this guy kudos for having a successful off field landing, his plane was not airworthy to start with, and should have never been flown until he fixed his leaking gas cap. I do not think any amount of remedial training, biennial or otherwise would teach this guy common sense and how to fly safely. Maybe I am too critical, maybe I am missing something. Hopefully, I am.

I responded: I was making a subtle point that he did a good job he should never have had to do in the first place. The *LESSON* was all about failure to perform the emergency checklist, and the greater need for all pilots to seek out quality flight instruction. But perhaps I was too subtle.

See http://www.mastery-flight-training.com/20120719_flying_lessons.pdf

Mr. Hershkowitz replied:

> Maybe it is just me being too sensitive. Once of the common themes I have seen is congratulating our fellow pilots for extricating themselves from situations they should have never been in (maybe we should call them "stupid pilot tricks"). I just feel the learning points on this incident should not be so much how he got out of it, but what he did to get into it. I agree with you he did a good job landing, but I still feel that your point about what we do in biennial training would have never prevented him from getting into this situation.... I try to use incidents like his to learn not what to do. I think often we bend over to congratulate others for extricating themselves from situations that could have been avoid....

…and "learning what not to do" is what *FLYING LESSONS* is all about. Thanks, Doug.

Recent *LESSONS* about thunderstorm avoidance and the inherent delay (and therefore, inaccuracy) of weather uplinks prompted this:

> Your anonymous and avid Pilot Fan here with a couple of seconds and a suggestion arising out of this and last week's *FLYING LESSONS Weekly*, Tom... First, on convective-weather encounters: It worth noting that pilots occasionally find themselves in weather worse than expected through no direct mistake on their part. My example is person: on a 600-nautical, mostly IMC cross-country some years ago in a Piper Comanche, a friendly TRACON controller who took me on hand-off offered a suggestion for avoiding a line of weather visible ahead: "My screen shows the weather better if you turn 20, 30 degrees right and hold that for about 30 miles..." Thanks to a break in the weather the line of storms ahead was clearly visible running from just north of the controller's airport and northeast for about 60 miles -- and moving east-northeast...so, the shorter, softer way was to skirt the closer end to the southwest...and that was the adjustment [I] made to my course -- about 25 [degrees] to the right and into soft clouds, rain free....for about 7 or 8 miles.
>
> That's when the weather turned savage right around me. Recognizing my situation as highly perilous prompted me to reduce power, trim to a slower airspeed well into the green, and make sure my flight bag and [I] were both well secured. What followed, I was later able to confirm on radar replays, was the line at my position going from benign to Level 4 in the span of about 6, 7 minutes -- out of my view since I was back in IMC.
>
> The plane was tossed, turned off heading at times, the VSI sometimes spiked to 4,000 fpm up while airspeed dropped before almost as quickly reversing to a climbing airspeed needle and a VSI showing 2,000, 3,000 fpm down. Throughout my focus was on keeping the airplane within 45 degrees of level, as close to neutral in pitch as possible, and just let the airplane ride it out. Knowing the airframe had a significant margin of strength because of my low weight, my target was to keep airspeed as close to the bottom of the green as possible.
>
> It wasn't fun, was exactly the opposite of pleasurable...but survivable, following all the tips imparted to my by two different Kansas CFI/Is familiar with turbulent air. My counsel for those who find themselves in convective conditions for whatever reason is: disconnect the autopilot. slow down, let the airplane ride the air without fighting it...and, as the *Hitchhiker's Guide to the Universe* wisely advises – "Don't Panic."

Thanks, anonymous. Your counsel exactly mirrors the Do's and Don't of Thunderstorm Flying in the FAA's *Aeronautical Information Handbook*: Avoid thunderstorms and their associated turbulence by a wide margins…but if you get caught, slow to well below Va (adjusted for your airplane's weight—about 2% lower for each 100 pounds below maximum gross weight in most

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general aviation airplanes); disengage the autopilot (which will fight excursions from straight-and-level flight, increasing stress on the airplane); tighten all seat belts and secure loose objects; lower the landing gear for additional drag in retractable-gear airplanes, but leave the flaps up; hold *attitude* and accept altitude changes as they come; and keep quoting Douglas Adams.

See www.faa.gov/air_traffic/publications/ATpubs/AIM/aim0701.html#aim0701.html.60

Anonymous continues with comments about our *LESSONS* about stalls:

> There's an easy way to learn how your airplane behaves at stall AOAs [Angles of Attack]-- go up and stall the airplane, at different altitudes, at different loads. This is an ongoing *LESSON* since different flights will have different loads. But do this and you'll more quickly recognize the mush, the stall without a break, know the accelerated sink rate...the works. Practice, practice, practice.
>
> Keep up the good work, Tom...it's a true Mitzvah to the rest of us...

Thank you very much, anonymous reader.

Reader Lorne Sheren also opines about the *FLYING LESSONS* on Angle of Attack:

> Good point about the angle of attack at Vx being close to critical Alpha. I recently installed an AoA indicator and the displayed AoA at Vx is quite close to the stall indication. I never appreciated this until I had this particular instrumentation. Gives cause for pause....

Thanks, Lorne. The context of this is two-fold: first, if the wing is stalled, it takes only a small reduction in angle of attack to put the wing into a high lift-generating condition (high Coefficient of Lift). As one reader commented, recover from the stall with the wing, add power to regain altitude. The second context is that a properly flown Best Angle of Climb (Vx) departure leaves little margin from a stalled AoA—pitch, bank, G-load, rudder coordination and AoA control are all critical in a maximum-performance departure.

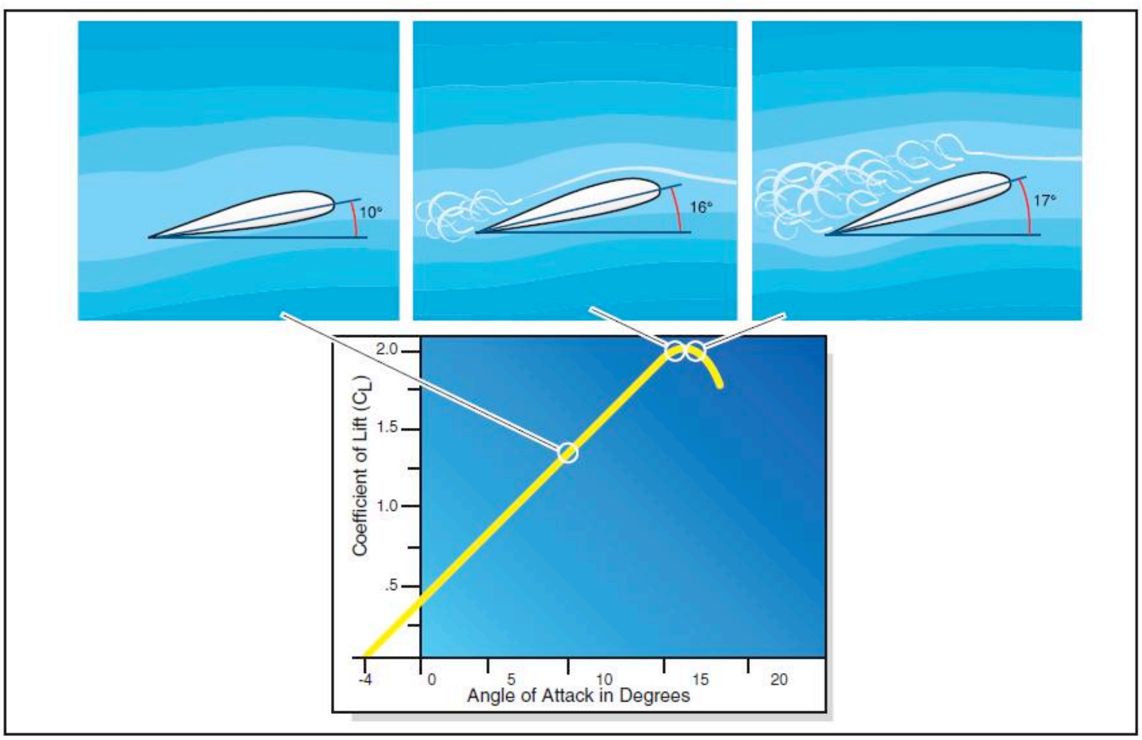

Figure 4-2. Critical angle of attack and stall.

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Reader Robert Thorson takes us back to the thunderstorm avoidance discussion:

> You have touched upon one of my favorite subjects: proper use of weather avoidance tools. I have several friends, other Captains, that see articles in the news media that perfectly describe driving airliners into convective cells. Passengers thrown around the cabin, luggage bins popping open, falling thousands of feet. Yet it is amazing to see the many terms of art used to relate what is a dangerous situation never properly labeled.
>
> In the early years of jets the radars had deficiencies and the concepts of high altitude flight, high and slow speed buffet were not entirely understood. These early jet Captains came from DC-3, 4 and 6 aircraft, where it would be common practice to tighten seat belts and drive through what they would describe as "orographic showers" and ridicule first officers who held on for their lives. When these first officers became Captains some appreciation for avoidance started to appear. The concept that the air at 7,000 feet was denser than 33,000 feet also became apparent.
>
> For the last 20 years or so the proper use of radar and other weather avoidance tools have not been fully taught or comprehended. The antenna tilt is set in fixed positions for takeoff, cruise and rarely used on approach. These are only general rules of thumb predicated in operating manuals. Modern radars have very thin vertical scans and the need for proper tilt is great. If a crew misses a storm 80 miles out the chance to see it at 20 miles will be missed because no one would ever adjust the tilt to 10-15 degrees down. The result is obvious. There are very good reasons why tilt must be constantly changed but few resources are available to teach the information. In all the many years of giving check rides in airliners questions on proper use of radar, high and low speed buffet and buffet margins were answered with blank stares. After a few minutes of discussion many more questions would come from the crew. They were actually "thirsty" for the knowledge. Thank all the engineers who have put the answers on EFIS airspeed tapes and have automated radars so pilots are protected from lack of knowledge in the future.
>
> But technology is appearing in GA aircraft. Lightning strike display scopes, NexRad, Infrared displays, anti-icing systems and many other technologies are available. So who teaches the proper use of these advanced devices? GA pilots, who are mesmerized by the technology, think they have more weather capability than they actually do and the trap is the same as the airlines. Lack of training and experience. The flight risk is still there it just appears differently.

As I put it in my lectures, airplanes have not become better at the aerodynamics of weather hazards just because we have filled their panels with new and better avionics. We still need to avoid thunderstorms by 20 miles or more, icing in almost all cases, moderate or greater turbulence at anything above moderate speeds and even then only away from the airport environment, and reduced visibility when that visibility is below the minimum required by our training, experience, currency, the airplane's certification and operable equipment, and the procedure we're flying. Advanced avionics don't make the airplane more capable, but when used properly they make us more capable at staying away from weather hazards. Thanks, Robert.

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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

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