FLYING LESSONS for July 21, 2011

suggested by this week's aircraft mishap reports

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This week's lessons:

This week's report builds on last week's FLYING LESSONS *on short-field takeoffs and landings by focusing and commenting on the reader responses we received.*

Debrief: Readers write about recent *FLYING LESSONS:*

Last week *FLYING LESSONS* covered techniques for short-field takeoffs and landings. Reader John Townsley writes:

> Short field techniques can, for the anxious, also create conditions for an inadvertent tail strike on takeoff or on landing. Watch the deck angle. A steep deck angle on landing indicates the aircraft is "hanging on the prop"… not a good place to be if the engine hiccups! A very steep deck angle on takeoff (on a short/soft runway) indicates the nose is way too high, resulting in excessive drag from the high angle of attack. Again, not a good place to be because it will slow acceleration and significantly extend the ground roll. Thanks for the excellent presentation of useful ideas.

Thank *you*, John. Yes, an excessive angle of attack on takeoff will seriously degrade initial climb performance. For short field takeoffs it's best to maintain a low angle of attack on the takeoff roll, reducing drag as much as possible so the airplane accelerates as rapidly as possible. At the prescribed short-field takeoff speed (see your airplane's Pilot's Operating Handbook or equivalent), translate pitch attitude smartly to the prescribed short-field initial attitude, which should result in Best Angle of Climb (Vx) speed, possibly adjusted for airplane weight if the manufacturer provides such guidance or you are able to compute the difference yourself (often about a 2% reduction in speed for each 100 pounds reduction in airplane weight). Vx will actually *increase* with an increase in density altitude, meaning you need to pitch to a slightly lower attitude when taking off from a hot and/or high elevation runway.

Not coincidentally, high density altitude situations are the ones where pilots tend to find themselves in the condition reader Townsley describes…at what appears to be the proper pitch attitude and deck angle, but which provides an excessive angle of attack and therefore too much drag to be overcome. The airplane will continue in ground effect until settling back to the ground, or impacting obstacles or rising terrain. In this dire situation the pilot's only possible escape comes from *lowering* the nose to reduce angle of attack and drag, when every instinct would be to pull back on the controls.

Learn from this video, which we've seen before in *FLYING LESSONS*, as it shows this scenario unfold with very unfortunate results. The NTSB concluded that factors contributing to the accident were the airplane's overweight condition, the high density altitude, the pilot's inability to compensate for a sudden wind shift, and rising terrain in the departure path.

See www.aopa.org/asf/epilot_acc/lax07fa258.html

Test pilot, instructor and examiner (and frequent *Debriefer*) Dale Bleakney adds:

> I was reading your article about short field takeoffs and landings and thought your readers might want to consider another twist to the issue of risk management during a short field takeoff.
>
> In a Cessna, the short field takeoff speed and best glide speed are real close together and in some cases, the climb speed is above best glide. So in the event of an engine failure [immediately after takeoff] you have a

> few a second or two to get the nose down before it gets real ugly.
>
> On a Bonanza [or similar, heavier airplane], the speed for short field takeoff is in the low 80-knot range and the best glide speed is about 105 or so. I recommend you take a look at what this means to you if you have an engine failure on a short field takeoff. I insist you try this at altitude first or there is a high likelihood you will bend an airplane.
>
> I set the scenario up by establishing a climb at Vx and at 200 feet or so about my simulated airport…pull the throttle to idle, pitch the airplane as needed to try to get as close to best glide as possible before the flare point, and land. The first time you do this, you will be lucky to not stall the airplane. If you are aggressive with the pitch, you can probably get the airspeed up to 75-80 KIAS to allow some elevator authority in the flare and you will land (simulated) firm but safe.
>
> I encourage you to try it and let me know what you see. Again, I do not recommend doing this anywhere near the ground until you have practiced a bit at altitude.

Thanks as always, Dale. I have indeed demonstrated this in Bonanzas at altitude. You're right...it takes a healthy, no, aggressive, push on the yoke. Here are two considerations, of which I am absolutely certain you are aware but which I'll include here for *FLYING LESSONS* reader contemplation and comment:

1. **Speed.** The speed you wish to aim for is a function of your current altitude, and what you plan to do with it (the altitude remaining). Unless you are a few hundred feet up and have the option of selecting a landing zone (as opposed to being forced to accept what's immediately ahead, if the engine failure happens *right* after takeoff), then Best Glide might not be the target speed for you. Many airplanes have *two* published Engine Out speeds: the familiar Best Glide, designed to permit covering the greatest distance for the altitude lost, and the Emergency Landing Approach (or similar) speed, which is the recommended speed for short final that results in the least rate of descent while providing enough airflow for control authority to arrest descent and permit directional control. These speeds appear in the beginning of the Emergency Procedures section of a GAMA-format Pilot's Operating Handbook (POH).

   Think of the two speeds as being analogous to Vy and Vx for climb—Best Glide gives the optimal *rate* of descent, similar in philosophy to Vy, while Emergency Landing Approach is like Vx, providing the optimal *angle* of descent. From altitude, following an engine failure you would generally descend at Best Glide speed until lining up with the landing zone. On final approach you would then slow to Emergency Landing Approach speed, extending flaps and landing gear as appropriate. This slows the vertical speed to minimum and also reduces touchdown speed, vastly reducing impact forces to make an off-airport landing far more survivable. If your engine quits immediately after takeoff, as in the short field takeoff we're discussing, translate pitch attitude to that necessary for Emergency Landing Approach Speed for an immediate landing on the best possible option ahead.

   For our A36 Bonanza example, while the published Best Glide speed is indeed 110 knots, the published Emergency Landing Approach speed is 81 knots—or about the same as the Vx speed you'd use in those airplanes for a short-field, obstacle-clearing initial climb. My Cessna 172S Information Manual tells me Maximum Glide speed at maximum gross weight is 68 KIAS, while the Landing Without Engine Power speed is 70 knots with the flaps up and 65 knots with the flaps down—all three speeds being very close to Vx in the venerable, late-model Skyhawk.

2. **Attitude.** If the airplane is properly trimmed for takeoff, trim will be set for hands-off flight at very near the Vx speed. Since this speed is very close to the speed you'd aim for should the engine quit immediately after takeoff, it seems logical that the airplane would naturally pitch for the proper speed when power goes away. Consequently, simply letting the airplane "do its own thing" will result in close to the optimal outcome from an engine failure immediately after takeoff…at least in theory. But read on…

   I train pilots to *aggressively* pitch down at the first sign of engine failure on takeoff. From briefing and initial practice they'll have a precise pitch target to aim for, primarily visually (which is how you'd be flying as you're clearing the obstacle) backed up by an attitude instrument reference (to provide precision in your flying). But why **push** the nose down to this attitude (which varies by airplane type) if the airplane is going to head there itself?

First, in attempting to seek its trimmed angle of attack, the airplane is not going to be precise. It "knows" it needs to pitch downward to increase speed and lower angle of attack (AoA), but it does not know *how much*. Consequently it will overshoot the nose-down pitch. The speed will build, pass the target/trimmed AoA, accelerate to a speed faster than target, then pitch up to reduce speed and aim for the trimmed AoA again. Given enough altitude a stable airplane with go through several of these pitch down/pitch up cycles before finding the attitude that maintains the trimmed condition. Trouble is, on takeoff you don't have much altitude. Likely an airplane left to its own devices would be nose-down and accelerating on impact if the engine quits immediately after takeoff and the pilot merely lets go.

Second, without power the angle of attack is going to increase rapidly for a given pitch attitude. Recall that a speed (an indirect measure of AoA) that will result in aerodynamic stall with power off can be a perfectly flyable and controllable speed with power on, a condition we call "slow flight" or, with a tighter definition, minimum controllable airspeed—proving that AoA varies with power setting for a given indicated airspeed   With zero power, when the engine quits the airplane will continue to follow a parabolic arc with an increasing angle of attack, literally "going ballistic" until other stability and aerodynamic forces take over.

Third, and the primary reason I teach pilots to **push** the nose following engine failure on takeoff, is so the pilot will *do something*. Our natural reaction when an engine quits on takeoff will be to delay, at least for a second or three, and deny there's a problem until it is obvious there is a real failure. We'll tense up, holding pitch attitude or, even worse, pull back on the controls in an instinctive attempt to keep from nosing in. During this very human period of indecision and inaction the laws of aerodynamics are acting mercilessly. Angle of attack is increasing, airspeed is dropping, and control authority is decreasing while we decide what to do. By the time we act it will take an aggressive push on the controls to overcome the conspiracy of aerodynamic forces.

Try this controlled experiment: With an instructor experienced and current in your airplane type, after clearing the airspace at a safe altitude, establish a trimmed, Vx climb, power on. Fly a power-on stall in the takeoff configuration (gear down, if retractable; flaps as appropriate for your airplane). Let the airplane climb; don't be hung up on the artificial Practical Test Standards criterion of holding altitude in a demonstrated stall, but instead actually learn something by simulating what would truly happen. When the airplane gives its first *aerodynamic* indication of a stall (not just the warning horn, but actual stall buffet or break, whichever happens first), carefully *hold a constant attitude* and **count to three** before you begin your recovery. This is simulating the period of denial we all must fly through before we choose to act. See what happens to airspeed and (if the airplane is so equipped) indicated angle of attack, and what an aggressive push it will take to get the wing flying again. Note you're doing this experiment with power still applied—if you chopped the throttle to idle at the stall warning horn and still held attitude after aerodynamic indication of a stall you'd get a better picture of the true scenario. But unless you're flying an aerobatic airplane with an experienced aerobatic instructor, that's farther than I'd encourage you to go to learn about your response to an engine failure on takeoff.

Telling pilots to *let the nose drop* at the onset of engine failure is passive, and may tend to prolong the delay in taking action. Teaching them to *push the nose down* to the proper attitude encourages snapping them out of the initial, utterly human phase of denial, and overcomes the increase in angle of attack and loss of performance that results in the seconds it takes for us to realize there's a problem and a need to act.

Comments? Questions? Tell us what you think at mastery.flight.training@cox.net.

Monthly update: Read these August 2011 articles by Thomas P. Turner in your favorite aviation publications.

See www.mastery-flight-training.com/this_months_articles.html

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Fisk Inbound #7: Wrap-Up

Flying to Oshkosh for the EAA's AirVenture convention and exhibition? You're running out of time to hone the flying skills you'll need to make a safe arrival. Get read by:

- Knowing the AirVenture NOTAM
- Having a backup plan, including fuel reserves and alternate airports
- Controlling your airspeed so you can mix in with a wide range of airplane types
- Flying tight patterns to spot landings
- Training your passengers to help you watch for traffic
- Practicing crosswinds, tailwind landings and go-arounds, just in case

If you do come to Oshkosh, consider attending my seminars on Saturday, July 30th:

- **The Psychology of Fuel Exhaustion** 10:00 – 11:15 am in the American Bonanza Society hospitality tent, immediately across the street from the Theatre in the Woods. It's not just Beech-specific, and you don't have to be an ABS member to attend—so stop on by!
- **Strategy to Avoid General Aviation Accidents** 2:30 – 3:45 in the FAA Safety Center, near the air traffic control tower.

See you there!

See: www.aero-news.net/news/featurestories.cfm?ContentBlockID=439EFF1E-2A8F-4F12-A1FD-13EF01B27318&Dynamic=1

The fifth most common cause of fatal general aviation aircraft, according to the U.S. Federal Aviation Administration: Controlled Flight into Terrain/Cruise Flight.

We had no responses last week, so we'll try this again. To kick off the discussion, here are three sample scenarios from the Federal databank. I'd like your ideas on possible factors that led to each crash, and ways a pilot might recognize and avoid similar situations. For each scenario please email mastery.flight.training@cox.net, focusing (but not limiting) your response on these items:

1. Cite the number of the scenario (which one you're writing about).
2. What do you think the pilot may have been able to do before takeoff to mitigate the risk?
3. What do you think the pilot may have been able to do in flight to mitigate the risk?
4. What hints might the pilot had that he/she was headed toward a mishap?

Scenario 1

During the night flight, the [helicopter] pilot was cleared through Class Bravo airspace and he queried the controller if there was an altitude restriction on his route. The controller stated that he must remain at or below 500 feet and that a frequency change was approved upon reaching a local geographical reporting point (Century Boulevard). A review of radar data disclosed that the helicopter followed an interstate southbound toward the destination airport. The radar data further showed that about 3 minutes prior to the last target, the helicopter's altitude varied between 200 and 400 feet mean sea level (msl). The last target was observed at a mode C reported altitude of 400 feet msl (about 250 feet above ground level), and located adjacent to Century Boulevard. Several witnesses reported observing the helicopter flying low southbound along the interstate. They then recalled seeing a bright spark as the helicopter collided with a high voltage transmission line, followed by the helicopter impacting the asphalt. The main wreckage, consisting of the fuselage and engine, came to rest in the far left lane of the seven-lane southbound side of the interstate. The wreckage was located almost immediately above Century Boulevard, which extended perpendicular (and under) the interstate. Power lines were located adjacent to the wreckage with two major steel support tower structures on either side of the interstate. Neither the towers nor the wires had obstruction markings or lights, nor were they required to have any.

Scenario 2
The flight departed in VFR flight conditions on a cross-country flight to the pilot's home airport. About 35 miles southeast of the destination airport, the airplane impacted the northwest side of an 11,000-foot mountain approximately 150 feet below the mountain's crest. Based on an analysis of the meteorological conditions existing at the time of the accident and in the vicinity of the accident site, the cloud bases were near 7,000 feet with the cloud tops above 15,000 feet. An Airman's Information (AIRMET) report for icing and turbulence had been issued for the time of the accident, in the accident area. An airframe and engine inspection revealed no preimpact mechanical anomalies that would have precluded normal operation.

Scenario 3
The airplane impacted a vertical rock cliff face in mountainous terrain about 500 feet below a mountain ridge line. Data was recovered from a portable GPS unit that was located with the airplane wreckage. The GPS data track originated in the vicinity of the departure airport, and proceeded at 8,350 feet mean sea level (msl) northeast for 57 miles, and abruptly ends in the vicinity of the accident site. During the last 2 minutes of the flight, the track increased in altitude from 8,350 feet to 8,891 feet msl. The height of the mountain ridge line directly ahead of the airplanes' flight path was between 9,100 feet and 9,580 feet msl. The end of the GPS track did not exhibit any deviations that could be interpreted as an evasive maneuver. The cloud coverage in the vicinity of the accident location was between scattered and broken, with bases between 8,000 and 9,000 feet msl, cloud tops were about 15,000 feet msl, with visibility greater than 3 miles in cloud-free areas.

Please send your insights to mastery.flight.training@cox.net. Thanks!

Publication note

Because of my duties during the EAA Convention, I will not publish *FLYING LESSONS* next week. I encourage readers to continue to comment, and to address the issues in the Top 10 Causes of Fatal General Aviation Accidents so we can wrap up the discussion of Controlled Flight into Terrain—Cruise Flight in August. The next *FLYING LESSONS Weekly* report will be dated August 4th.

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