FLYING LESSONS for September 1, 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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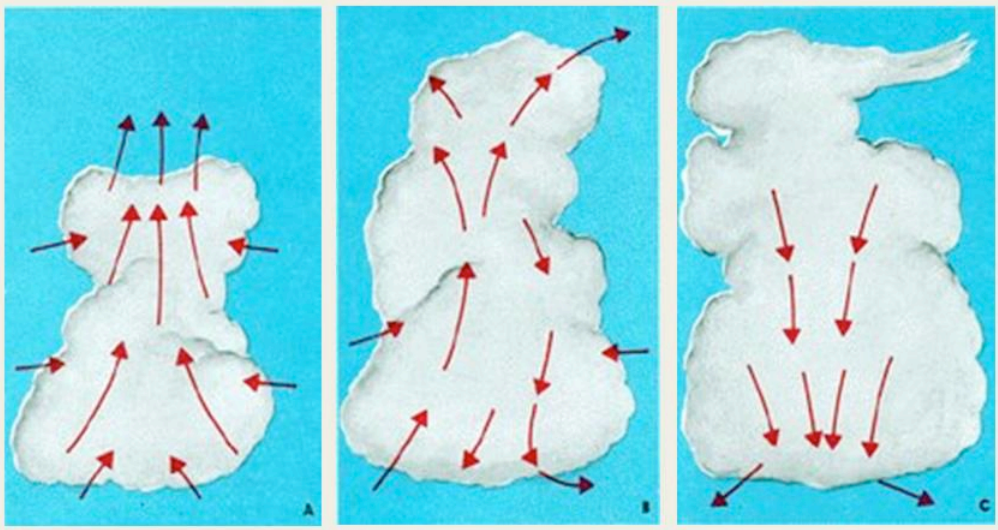
This week's lessons:

Nexrad weather radar uplink is one of the most significant improvements in aviation safety in the past decade. As GPS moving maps took a lot of the mental imagery required in navigation, so has airborne weather depiction made tracking precipitation and storms much easier and less subject to misinterpretation.

We must be cautious, however, that if we have data uplink capability that we properly evaluate the information it gives us. Assuming a fully functioning transmission and reception system, there will be some lag between the radar sweep that results in detection and eventual display on your cockpit monitor.

A lot can happen during that delay to alter the picture. A storm cell may form, mature and die away in less than half an hour's time. Dangerous turbulence will exist before precipitation begins, and therefore before the cell appears on radar. Empty space in air masses can fill; gaps in lines of storms can close, before you'd ever see a difference on the uplink's display.



An individual thunderstorm cell within an air mass or along a frontal boundary can form, mature and dissipate in as little as 20 to 30 minutes. In its earliest visible form, the **cumulus or updraft stage** (left), vertical air currents may exceed 3000 feet per minute. By definition precipitation has not begun in this stage, so *although turbulence may be severe the cell will not yet appear on radar.* A thunderstorm enters the **mature stage** (center) when precipitation begins to fall. By the time the cell *first becomes visible on radar,* violent up- and downdrafts at up to 6000 fpm mean *severe to extreme turbulence* within and near the cloud. The final, **dissipating or downdraft stage** (right) is marked by *heavy precipitation (and therefore visibility on radar),* and downdrafts at up to 6000 feet per minute. *Turbulence may be extreme;* this is the stage when the threat of flying beneath the cell and near the surface near and downwind of the cloud is most hazardous because of the threat of *microbursts and low-level wind shear.*

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Like other storm detection devices such as lightning detectors ("spherics"), Nexrad weather radar uplinks are best used to avoid areas of suspect thunderstorm activity, based on preflight information and inflight updates on the conditions conducive to thunderstorm development, and a subjective evaluation of the precision of the forecast based on whether storms are forming in the general area of your route.

Nexrad uplinks are not so good as a means of picking a path around storms, because the turbulence you're really trying to avoid is independent of the Nexrad picture (cumulus-stage storms are dangerous but not visible on radar), and because the delay between observation and cockpit display means what appears to be a safe route on the 'scope may not be truly safe.

We must fly four-dimensionally, taking observations with our weather sensors, display and our own eyes, then combining those observations with our knowledge of weather systems from our preflight briefing, updates we've received en route, and our own (hopefully substantial) understanding of the factors that lead to adverse weather development and the life cycle of weather hazards like thunderstorms.

Nexrad uplinks don't change a thing about your airplane's ability to fly in turbulence, hail or heavy precipitation. All they do is let us see farther ahead of the airplane, so we can progress into conditions that might have created greater pause without Nexrad's long-range vision.

Ultimately we still need to stay out of the build-ups, with greatest success coming when we can visually avoid "clouds of extensive vertical development" by no less than 10 to 20 miles.

It's tempting to pick up some "free" airspeed in the descent from cruise altitude. Point the nose down, keep the power up, and watch the airspeed build.

Piston-powered airplanes have a "yellow arc" on the airspeed indicator that is by definition a "caution range." The airplane should only be flown at indicated airspeeds in the yellow arc "in smooth air."

Turbine-powered airplanes don't have an airspeed indicator caution range. Instead, they have a maximum "barber pole" maximum indicated airspeed that often varies with altitude and changes in environmental conditions. Piston-powered airplanes that are modified with turboprop powerplants lose the yellow arc on their airspeed indicator, with the new never-exceed speed being marked as the top of the original indicator's "normal operating range" green arc.

The yellow arc is designed to protect the airplane (and its occupants) from damage if the aircraft encounters turbulence. Yellow arc (or beyond barber pole) speed is well above the aircraft's Turbulence Air Penetration Speed (V_A or V_B), which in turn will reduce with a reduction in airplane weight (OK, V_A is a single, fixed speed, defined at the airplane's maximum weight. But the "V_A effect" drops as the airplane becomes lighter). The idea is to prevent the airplane from being damaged by an encounter with turbulence—keep the speed in the green arc during descent so if you descend into the bumps you'll avoid structural damage.

What about the safety margins built into aircraft certification? Most pilots have heard that airspeeds and airplane G-load capability has a 50% margin for safety…that an airplane stressed in the Normal category for 3.8 Gs, for instance, is really protected in up to a 5.7 G turbulence encounter.

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Well, not really. The FAA establishes two kinds of load conditions:

- **Limit Loads** are the maximum loads expected in service. FAR Part 23 (and most other regulations) specifies that there be **no permanent deformation** of the structure at limit load.
- **Ultimate loads** are defined as the limit loads times a safety factor. In Part 23 the safety factor is specified as 1.5 times the limit load. For some research or military aircraft the safety factor is as low as 1.20, while composite sailplane manufacturers may use 1.75. The structure must be able to withstand the ultimate load for **at least 3 seconds without failure**.

What this tells us is that we indeed have a 50% margin above limit load for our personal safety, but that anything above the design limit load may cause permanent damage to the primary aircraft structure, i.e., it may total the airplane.

This applies only for **symmetric flight conditions.** Asymmetric loading (pulling Gs while rolling, yawing or rapidly changing pitch) may reduce the limit and ultimate loads to as low as 75% of the above values. Load limits are usually significantly less with flaps extended. Aftermarket modifications, such as vortex generators, may further alter the speeds at which you might reach design and ultimate limit loads.

You don't want to exceed design limit load, even once, if you want to keep flying the airplane. Here's another situation where you need to fly in the fourth dimension—time—and predicting when you *might* encounter moderate or greater turbulence, so you can slow the airplane before encountering the first bump…because waiting until you begin hitting strong turbulence at a high speed may be too late.

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

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The fourth most common way people die in general aviation airplanes is Collision with Obstacles or Terrain during Low-Altitude Maneuvering Flight. Last week's report included narratives of four scenarios representative of this cause, which most frequently results from "buzzing" at extremely low altitudes or attempted low-altitude aerobatics.

See www.mastery-flight-training.com/20110825flying_lessons.pdf

As I wrote last week, it's unrealistic to think the highway buzzers and quarry skimmers and amateur aerobats are going to read something like *FLYING LESSONS*, recognize the error of their ways, and reform to be better citizens of the air. If there is to be a change it's one that must be driven by people like *FLYING LESSONS* readers. That's why I asked you to answer these questions:

1. How do pilots like this sneak through the cracks of flight training and medical certification?
2. Who is best positioned to identify pilots like these, and what should those persons do to intervene before the pilot kills someone and removes another airworthy airplane from our dwindling fleet?
3. Is there anything we the general aviation community do, consciously or subconsciously, through

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words or actions, that reinforces this type of activity?

4. What responsibility do we have to ground pilots who act like this?

Only two readers have written so far. Dr. Bill Rhodes writes:

I'll take you up on the challenge to respond:

1. How do pilots like this sneak through the cracks of flight training and medical certification?

The flight training system with which I'm familiar is oriented around the performance of tasks. It does not emphasize developing the character of a pilot. Accordingly, it produces pilots who can demonstrate skills but who sometimes fail to understand what those skills are *for*. It is one thing to have skills; it is another entirely to possess wisdom and self-discipline. The system is better at teaching (and evaluating) the former than it is the latter. Likewise, the medical certification system is designed to check for diseases, and it seems to work well on that front. The weak judgment and lack of self-mastery we sometimes see as causal factors underlying mishaps are for the most part off the medical radar, I suspect.

2. Who is best positioned to identify pilots like these, and what should those persons do to intervene before the pilot kills someone and removes another airworthy airplane from our dwindling fleet?

My experience tells me that other pilots are generally not surprised when a rogue pilot gets hurt or killed. Experienced, mature pilots are frequently the best positioned to diagnose scary pilots.

Bringing the matter up seems to me to be the first step. Naturally, however, this is best done tactfully and armed with specifics with a focus on improvement. Over the long run, I hope we can foster a culture in which we can all take observations and suggestions in a professional spirit. Honesty signifies friendship.

3. Is there anything we the general aviation community do, consciously or subconsciously, through words or actions, that reinforces this type of activity?

Culture influences the development of character. People will often imitate what it would be difficult to *compel* them to do. Any culture that would improve itself would probably do well to examine what it celebrates and what it disdains. If risky showing off is applauded, we'll get more of it. If mature self-control is celebrated, we'll get more of that. Being aware of the example we set is a good thing. Being careful to set a good example is even better.

4. What responsibility do we have to ground pilots who act like this?

That depends upon who "we" are. In hierarchical organizations, of course the leadership has a responsibility to restrict dysfunctional behavior. But GA is for the most part not a hierarchy. I suppose that the insurance industry has an influence, but not to the extent of grounding pilots. Rather, they help mostly by shaping aircraft selection to pilot experience level.

I think we are better off in the long run by helping develop pilots who decide to control themselves for their own *good* reasons. Generally speaking, a large part of being a professional is knowing one's limits and respecting them. Indeed, I've heard professional ethics described as a "science of limit."

Most of us have indeed "grounded" ourselves at times. On those days we avoided becoming a statistic. Similarly, most of us have been tempted to do something unwise, and successfully resisted that temptation. Tomorrow will be a better day if more of us freely decide to behave wisely; that requires surfacing these topics as professionally-minded aviators, studying them (especially as they apply to ourselves), and putting what we learn into action.

Reader David Heberling, no stranger to the *FLYING LESSONS* discussion, adds:

Before I comment on maneuvering flight accidents, let me relate to you an incident of my own. Back when I was a newly minted private pilot, I was a senior in high school. Before we graduated, I took a couple of friends flying with me in a Cherokee 140. During the flight, I decided to take them to my favorite grass field airport. It was an airport my flying buddies and I used to frequent on solo flights. This airport was a challenge in several respects. First and foremost, there was a large hill at the north end of the runway. A road ran along the top of the hill along with the telephone lines. On the other side of the road was a gravel quarry. On the southern end there were trees but they were separated from the runway by an open field. Also, the runway sloped down in that direction.

When we arrived at the airport, the wind favored landing to the north. This was accomplished with no problem. When it came time to take off again there were several things I would have to consider before doing so. Calculate the density altitude. Determine the take-off distance according to the POH. Did I do any

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of these things? No. I might have even considered the advantage of taking off downwind to the south aided by the slope of the runway. Did I do that? Nope. How about the fact that I would be taking off in the heat of a summer day in the heavily loaded Cherokee? Nope. None of this dawned on me until the actual event itself.

I taxied to the southern end of the runway to take off to the north. There was a light breeze from the northwest blowing. I advanced the throttle to full power and we were off rolling down the runway. At the midpoint of the field, I noticed we were still not airborne. This caused me some concern. By the time we were three quarters of the way down the runway we still were not airborne. I was really sweating now. At the last possible moment, I popped on two notches of flaps. We leaped off the runway and zoomed up the hill in ground effect. Barely clearing the wires, I dove into the gravel pit to gain speed and retract the flaps. As we climbed out of the gravel pit I looked over at one of my schoolmates. He was having the time of his life. I thought to myself that he had no idea how close we came to being dead. For me it was one those flights that scared me silly but taught me so much. It was also one of those flights where I was just a passenger who also happened to be controlling the airplane. I intensely disliked that feeling, but it took me awhile to learn what being in command actually meant.

For the actual scenarios there is a common thread through all of them. All of the pilots were addicted to the exhilaration of speed. They had done these maneuvers before. They had no idea what kind of loads they were putting on their airplanes nor how much physical room was necessary to recover from those kinds of maneuvers. There were really no pilot-in-command of these flights. They were all passengers who happened to be in control of the airplane. So when the end came they really had no idea why this was not working. Survival is usually required to learn from your mistakes.

I agree with the FAA's do's and don'ts about maneuvering flight. What I question is what do they consider a safe altitude. Barring obstacles, how low is too low to perform stalls? One of your readers said that anything below 1500' AGL is considered aerobatic flight. Just doing a stall at 1,000' AGL is aerobatic flight? I have never seen the light go on in someone's head like I did when we did these low level stalls.

How do we stamp out these acts of stupidity? Taking away their certificates will not stop them. If they own their own plane, they will fly anyway. All we can do is speak out against that type of flying. Do we then shun the perpetrators? One could end up quite friendless if that is the case. To many pilots, the ability to do what ever you want to do in an airplane is the definition of true freedom. If you speak out against that thought, you run the risk of doing so alone.

Thank you, gentlemen. Part of our problem is that as a pilot community we don't want to think about the questions, I fear. Unfortunately, every airplane that goes down under these sorts of circumstances only reinforces the general public's image of personal aviation as unmanageably high-risk, undertaken by wild cowboys for whom safety is a four-letter word.

Perhaps this particular Cause is an unsolvable problem. If we must accept that (and I'm not certain we do, not yet), then we should work so this is the last remaining major cause of fatal general aviation accidents. We'll do that by positively addressing the areas where well-meaning, regulations-following pilots who normally exhibit what most of us call "good judgment" and even "common sense" somehow make a decision we (and likely they) would never envision being made while in the command seat of a general aviation airplane. If we are successful there then these "unreachable" pilots will be the only major group of fatal mishaps left. We can hope….

I still invite and need your comments on Top 10 Cause #4. Let us hear from you, at mastery.flight.training@cox.net.

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

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