FLYING LESSONS for August 24, 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.

If you wish to receive the free, expanded *FLYING LESSONS* report each week, email "subscribe" to mastery.flight.training@cox.net.

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FLYING LESSONS is a couple of days late this week because of unrelated workload issues. I apologize for the delay.

This week's lessons:

A friend and co-worker finally ended a long hiatus in his initial pilot training today. His desires and my urging got him scheduled in the left seat of a local trainer this afternoon—the first rainy day in Wichita since mid-May, according to local news sources. Excited and a little anxious for his afternoon lesson, his first move from a Cessna Skycatcher into the roomier Cessna Skyhawk, he came to me about noon worried the storms outside might cause him to cancel his lesson.

"Plan on going anyway," I advised, "and if nothing else, sit in the airplane and practice the checklists. But I bet you're going to learn a very important *LESSON*," I continued. "Almost always, if you wait just a couple of hours the weather will get better. That's something to remember every time you're tempted to take off in marginal weather." My friend called me after he completed his *LESSON* and, sure enough, although he and his instructor flew through some very light sprinkles, the weather had in fact improved markedly, and he had a fantastic time in his first flight in the iconic Cessna 172.

Uncommanded propeller speed increase may be related to a loss of oil. It could also be a result of a propeller governor failure, or a failure in the propeller dome or the crankshaft. Engine speed does not always equate to power development with a controllable-pitch propeller.

Manifold pressure is just that—a measure of the air pressure available in the engine's intake manifold. Manifold pressure, then, represents the *potential* for power development.

Combustion requires a proper mixture of air and fuel, ignited by a well-timed spark. The manifold pressure gauge tells you how much air is available to be combined with fuel; if you add the proper amount of fuel power will result. All the fuel flow in the world will not give you more power than what's appropriate for the air available.

So how can you measure power development? In its simplest form you can approximate power output by evaluating the aircraft's performance. This subjective evaluation is the only way to tell in a great many airplanes, especially with fixed-pitch propellers.

If a piston engine is instrumented for it, exhaust gas temperature (EGT) or, with turbocharged engines, Turbine Inlet Temperature (TIT, which is simply an EGT gauge referencing temperature just as exhaust enters the turbo), is the most direct measure of power. Manifold pressure, rpm, cylinder head temperature (CHT) and even fuel flow are merely indicators of *potential* power development.

Turbine engines have various, more direct means of measuring power output, including torque gauges, temperature indicators, and percentage of thrust meters that reference more direct-reading sources to compute power.

See my article Manifold Pressure: What It Tells Us, What It Doesn't for more on power indications. You'll need to register (free) and log into www.iplot.com's for *Insider Series* articles.

www.ipilot.com/index.php/learn/8-continuing-educaton/987-manifold-pressure—what-it-tells-us,-what-it-doesn't

I had to make an extremely difficult and, for many people, unpopular human factors decision this week, and cancel an aviation training event. Most objective indications pointed to a "go" decision—but the wise counsel of some fellow instructors confirmed that the issues of instructor pilot distraction and fatigue were too great to accept the risks. *Sometimes flying is like that*. Sometimes all pilots need to make the tough decision. I hope I have the clarity of mind to avoid temptation in all my flying decisions, and you have that same veracity regarding flying.

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

Debrief: Readers write about recent *FLYING LESSONS:*

Don't be dense, continued:

Reader Tom Allen continues the discussion of density altitude:

> Years and years ago, my friend and I flew a [Cessna] 172 from Dallas to San Antonio one summer morning. He and I had flown this plane many times. Upon departing SAT in the afternoon, it was a really hot, windy summer day and I was PIC. We were full of fuel and the takeoff roll did not seem usual. It didn't seem to be performing that well and at about 1,000 feet it started to sink. I was concerned that we could not turn so I started descending to gain speed, then climb back up, then descend, then climb. We were able to stay at roughly 1,000ft. This went on for several minutes until finally we able to fly level. S minutes later we could climb at about 100 fpm. I was told later that a mechanic determined that it had the wrong prop.

Thanks, Tom. It may have been the incorrect propeller for the airframe/engine combination (an airworthiness problem), or the Cessna may have had a propeller that is approved but was the wrong propeller for the application.

Fixed-pitch propellers come in three varieties: cruise props, climb props, and a compromise between the two. The difference comes from the propeller pitch, or angle at which the blades are mounted on the fixed hub. A cruise propeller is mounted at an angle to the direction of flight that reduces drag at a cruise angle of attack to make the airplane fly faster, but does not generate maximum thrust in a climb attitude so climb performance suffers. A climb prop, as the name suggests, has blades mounted at angle to generate more thrust at high angles of attack to climb better, but cruise performance suffers. Compromise propellers are not optimized for either but provide a good middle ground.

It may be that your airplane had an illegal propeller. More likely, it had a cruise propeller when that day, under those conditions, you really needed a climb prop. Aircraft performance charts are based on whatever the manufacturer originally selected for the type, but it may have been perfectly legally modified in the years (or decades) since the airplane was new. Regardless, thanks for relating your density altitude experience so we can all learn the options you described for what could easily be described as an emergency.

Reader Woodie Diamond sent this in-cockpit video of a Kitfox aircraft that was landing "flat," or at a shallow descent angle like we often see on instrument approaches, when it impacted a power line on short final. Check how hard it is to see the power line when focusing on the runway, and how low to the ground and close to the runway the lines are—a good reminder to stay higher and descend more steeply when landing in VMC and when descending beyond the Missed Approach Point on an instrument approach. Luckily, the pilot and his grandson were not seriously hurt.

As Woodie put it, Didn't you just write about power lines not too long ago?

See http://abcnews.go.com/blogs/headlines/2012/08/michigan-plane-crash-captured-on-video/

Frequent Debriefer David Heberling checks in about recent *LESSONS* about stalls and collisions with terrain with the airplane's center of gravity (cg) position as a contributing factor:

It surprises me that you attribute a forward CG to take off accidents with high density altitude. Most pilots are used to forward CG scenarios because that is what we usually fly with when flying alone or one other person. It is when we load our airplanes to max gross (or beyond), by filling the seats and loads of bags that pilots run into problems. A most rearward CG, while still in the envelope, presents a totally different airplane to what the pilot is used to at a most forward CG. The elevator control forces become much lighter, and the airplane is less stable. If the pilot is used to flying alone with a forward CG, he may forget to re-trim the elevator for the rearward CG. This would explain why many accident airplanes get off the ground early and at a high angle of attack in high density altitude situations. Many witnesses also say that the pitch control was erratic. This can be explained by the much lighter elevator control forces with a most rearward CG.

I believe we're in agreement, David. Forward cg conditions increase takeoff roll and reduce climb rate, making failure to climb above obstacles more likely. As you correctly describe, however, more rearward centers of gravity make the airplane less stable and more likely to nose upward, making stalls more likely. In some airplanes (like the Beech types in which I'm most familiar) stalls happen much more frequently on takeoff or go-around than they do in the classic turn-to-final scenario, and when stalls do occur in those types, the airplane is usually loaded near (or beyond) the aft cg limit. David continues:

I have seen most rearward CG effects in my own airplane. I went to Oshkosh for the first time this year and took my cousin and his 12 year old son. We were at max gross weight and most rearward CG when we left on Saturday. From past experience, I know to set the take off trim to zero or slightly less under these conditions. My normal take off trim when alone is 3. That is a pretty big change in trim. I also let the airplane tell me when it is ready to fly. This way **I am not tempted to force it off of the ground**. For performance, **I used the POH performance charts to generate a worst-case table for takeoffs with and without an obstacle**. I find this table much easier to use because I can tell how much runway I need at a glance for the given conditions.

I do not know how much effort most pilots put into figuring out their weight and balance for flights at max gross. I do know that I spent several hours weighing everything that was going into the airplane, and then putting pencil to paper to figure out the weight and balance. Several iterations later, I found the solution staring me in the face for 15 minutes before I realized that I had solved the tricky problem of keeping the CG within the aft limit and under the max gross weight limit. I had to do it again for a trip with my wife, daughter, and her boyfriend on a trip up to Cape Cod. **Weight and balance calculations are not trivial and are essential for a safe flight especially at high gross weight.** It is not all that hard to do, but time has to be invested to do it right.

You're absolutely right, David. In fact I was having this conversation with *FLYING LESSONS* readers Bruce Landsburg, David Oord and others from the AOPA Air Safety Institute last week—that the problem is not usually that pilots do not visualize where the airplane will lift off based on their takeoff planning so they know when to begin an abort, it's that most pilots don't spend enough time with the Performance charts to know what should be expected, especially in high weight and/or high density altitude conditions. Thanks, Dave, as always.

Last week's *FLYING LESSONS* included commentary on a 17-gph cruise airplane's fuel exhaustion event after taking off on a 1:30 flight with 33 gallons of fuel on board. The *LESSON* reviewed the need to consider takeoff and climb fuel burn, and not just mentally figure endurance using cruise fuel burn as your guide.

Reader Roger Merridew relates his rule of thumb for estimating endurance:

We have been running a GA training school for the last 40 years and 280,000 hours in Victoria, Australia. Basic training is in [Piper] Warriors and we use [Beech] A36s and a B95 Travel Air [twin] for advanced training. Additionally we do IFR charter in A36, B95 and PA31 [aircraft].

Fuel planning has always been the same for all classes of flight as follows:

- Determine a cruise fuel flow for the aircraft type (generally 65%)
- Determine the expected flight time from speed and route miles.
- Calculate fuel required based on 65% rate.
- Add 15% more fuel for uncertainties in wind and engine power, mixture handling [leaning technique].
- Add 45 minutes (fixed fuel reserve, mandatory in OZ)
- Add 15 minutes for every take off and climb in the mission (including the first one)
- Add holding fuel as required at holding power fuel flow (2/3 the 65% rate).

On this basis a normally aspirated A36 on a 1hr flight would require the following fuel on board at take-off:

- 13.8 usg for 1 hr
- + 2.07
- + 10.4
- + 3.45
- Total 29.72 usg.

If there is to be an en-route stop then another 3.45 US gal would be required. This has worked for us and many post flight fuel checks confirm its accuracy.

Let's look at the A36TC mishap from last week's report. At 17 gph and using your formula, it would take 36.55 gallons *before* adding reserve and holding fuel. As expected, a 1:30 flight in an airplane averaging 17 gph in cruise will use more than 33 gallons. Thanks very much, Roger.

And FAA Safety Team Outreach Manager Bryan Neville echoes my exasperation with pilot-instigated, fuel-related mishaps:

The topic of fuel is high on my hit list. I'm always amazed when I talk to a pilot who survived a fuel-related accident. They have the most amazing reasons!

Share safer skies. Forward *FLYING LESSONS* to a friend.

Personal Aviation: Freedom. Choices. Responsibility.

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