FLYING LESSONS for October 7, 2010

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.

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This week's lessons:

What about this *doesn't* suggest fuel exhaustion waiting to happen? From the NTSB: "The airplane's engine 'revved up and down, 3 or 4 times' before losing power…. [An] FAA Inspector, who examined the aircraft on-site, reported that it appeared the aircraft had "blue stains" on the underside of the fuselage and that the fuel caps had duct tape on them."

Flight with known mechanical discrepancies is often implicated in an engine failure or loss of control mishap. Some system abnormalities or failures do not by themselves adversely affect safety of flight. Most have at least the potential to create trouble, either by failing completely, contributing to additional or worse outages, or by their absence making it easier for the pilot to lose situational awareness.

Pilots of U.S.-registered airplanes have specific guidance to help us make decisions about the potential safety-of-flight impact of equipment outages. Foreign-registered airplanes likely have similar or even more definitive guidance.

FAR 91.213(d): Inoperative instruments and equipment. A person may takeoff an aircraft with inoperative instruments and equipment without an approved Minimum Equipment List provided—

> (1) The flight operation is conducted in a nonturbine-powered airplane; and
>
> (2) The inoperative instruments and equipment are not indicated as required on the aircraft's equipment list, ***or on the Kinds of Operations Equipment List*** for the kind of flight operation being conducted (emphasis added).

Airplanes need certain equipment to fly safely in VMC, at night, and in IMC. Each aircraft type is certified to a "type design" that conforms to a document called the Type Certificate Data Sheet (TCDS). This is often called the TC, or type certificate. The TCDS describes the terms of aircraft certification. You can find the TCDS for your airplane on the FAA's website.

See www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/MainFrame?OpenFrameSet

Each TCDS is a very long and sometimes convoluted document that means a lot to regulators and aircraft manufacturers, but is very unwieldy for use in the cockpit. Yet for an airplane to be considered "airworthy" the pilot is responsible to determine it conforms to the TCDS requirements for the type of flight to be flown.

Fortunately many aircraft manufacturers make this determination easy. In the Limitations section of the Pilot's Operating Handbook (POH) there may be a table called the Kinds of Operations Equipment List (KOEL) or similar. The table identifies the systems and equipment upon which type certification for each kind of operation was predicated. In this context “kind of operation” means VFR day, VFR night, IFR day or IFR night flight. Airplanes certificated for flight in icing conditions (“known ice”) also include “icing conditions” as a kind of operation. In some cases only one of a set of redundant items may be required; in others both might have to be working. As a “limitation” these tables, if they exist for the airplane you’re flying, are legally binding for aircraft operation.

SYSTEM and/or COMPONENT	VFR DAY	VFR NIGHT	IFR DAY	IFR NIGHT	ICING CONDITIONS
VACUUM/PRESSURE SYSTEM					
1. Instrument Air System	0	2	2	2	2
2. Pressure Gage	0	1	1	1	1

A section of a KOEL from a typical Pilot’s Operating Handbook

Under U.S. rules, then, the order of priority for determining whether the airplane is airworthy with an item of inoperative equipment is:

1. Minimum Equipment List (MEL): If the item is listed on an approved MEL for that airplane, then it cannot be flown with that item inoperative.
2. Kinds of Operation and Equipment List (KOEL). If there is no MEL but the airplane’s handbook has a KOEL, then all items listed as required for the type of flight to be flown must be operative for the flight to be made.
3. Regulations and pilot judgment. Only if there is no MEL and no KOEL, the pilot may make a judgment about the safety of flight so long as the inoperative equipment is not required for the type of flight—IFR, night and/or VFR—under FAR 91.205.

It’s this judgment that separates the safe pilots from those who are “accidents waiting to happen.” If you find yourself “field-modifying” the airplane (duct-taping the fuel caps to try to prevent leakage, for example), or working out some contortion to do supposedly simple tasks like switching fuel tanks or latching the seat position, use these unusual actions as reminders that 91.205 and 91.213 (and their international equivalents) are there to help us benefit from the expert judgment of the airplane designers.

A rapid pitch change will increase G-load and, with it, angle of attack. Although the nose of the airplane is pointed one direction, the airplane is actually flying in another.

Pull up sharply out of a go-around, over-rotate on takeoff, pull hard out of a glide, or yank aggressively at the bottom of a loop, and the airplane will stall well above the Pilot’s Operating Handbook stalling speed.

(left) High-G, high AoA flight can cause condensation in moist air . Visible water makes it easy to visualize this F/A-18 pointed upward, yet traveling much more horizontally.

Pull Gs, and you're pulling an increased Angle of Attack (AoA). Visualize the effect of load factor on stalling speeds. When the wing is under a positive load, your airspeed indicator doesn't tell the whole story about stalling.

Fortunately there are technologies that directly display AoA. Next week we'll look at some of the options, their advantages and limitations, and why you may want to consider an AoA meter for the airplane you fly.

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

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Debrief: Readers write about recent *FLYING LESSONS*

Reader Mark Briggs addresses a recent *LESSON* on fuel management:

> As always, this week's *FLYING LESSONS* is a good read and a great opportunity to learn. I noted with particular interest your comment that "**Fuel exhaustion really begins** before the pilot walks out to the airplane."
>
> This statement rings very true for me. On a recent cross country flight, with no option for an intermediate fuel stop, I encountered headwinds more than double those forecast. As a VFR pilot I was beginning to become concerned about fuel reserves as I had to divert around areas of heavy precipitation and/or reduced visibility. I'm fortunate in that my aircraft fuel supply makes for very easy mental math, and despite what any regulations might mandate, I won't fly with less than 60 minutes of fuel in the tanks. When preparing for this flight I mentally ran "what if" scenarios and had pre-determined turn-back points planned. If I hadn't reached a specific distance from destination after a specific amount of time enroute, I would turn back. This kind of planning is something that I consider to be mandatory before even walking out to the plane. And once at the plane I dip the tanks every time so there's no guesswork about how much fuel is on board at the point of departure.
>
> As satisfying as it is to make a landing that's a "squeeker", I find it just as satisfying, and just as much a mark of pilot expertise, to be able to tell the FBO exactly how much fuel the aircraft should need, based on en-route fuel burn calculation. It's been a while since I was off by more than a gallon. This is pretty simple stuff and I so wish more pilots would get into the habit of making fuel management a matter of personal/professional pride.
>
> Please do keep up the excellent flow of safety information to the pilot community.

Thanks, Mark. Regarding Phil Webb's comment on high altitude takeoff, Marty Vanover replies:

> Phil Webb is right. I was most likely near the best rate of climb speed when I finally found a speed that produced some climb that day out of Payson. This got me to thinking about Vx and Vy. So, I did some research. I recall my first flight instructor mentioned that Vy decreases about a mph per 1000 ft. But, that was *his* "rule of thumb". It is actually a function of weight, which affects stall. I graphed my Vx - Vy at a couple of weights and found it interesting. While calculating the Vx and Vy for every takeoff is probably not necessary, it would be useful to know how to find it for your airplane. I graphed it using a typical takeoff weight. I found my indicated stall speed for that weight and estimated the absolute ceiling altitude (where Vx and Vy converge) and added a knot. Then I use my published Vx/Vy speeds and connected the dots. Not really exact, but it will be close enough to know how much Vx and Vy speeds would be reduced at altitude in relationship to the book published values. At my "typical" T/O weight of 2500 lbs, my Vy would be about 80 KIAS at 5,000 ft., 77 at 7,500 ft. and 74 at 10,000 ft. I am sure those values are pretty close to the actual speeds. I am sure there are formulas for calculating this, but I've never seen one. It was interesting that it worked out to about a knot per 1000 ft. Maybe I have found *my* "rule of thumb", then again my old flight instructor could have said "a knot per 1000 ft.".

And reader Gregg Jaskiewicz reminds us:

> You need to lean mixture before taking off. People are taught incorrect to always set mixture to rich. And that obviously doesn't work at high alt aerodrome.

Absolutely, Gregg. Thank you both.

Fly safe, and have fun!

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2010 National FAA Safety Team Representative of the Year
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