FLYING LESSONS for September 15, 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.

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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This week's lessons:

Think back to your very first flying lesson. No doubt you walked through a preflight inspection with your instructor, then settled into the left (or front) seat for the first time. Though it seems so simple to you now, you were amazed at the complexity of the controls and instruments and radios in that little trainer. You were probably relieved when your instructor handed you a small book or a laminated card that contained everything you needed to do, in sequential order, to make sense out of this chaos and bring a seemingly complex machine to come to life and then to fly at your command.

Read a step, do a step ... that's probably how you learned to use this checklist. This is an effective way to learn the proper order of actions, but there are two very common errors associated with this type of checklist use:

- Using the checklist as the instigator of your actions makes it very cumbersome to use, especially once in the air.
- The checklist is seen as a temporary crutch to be overcome, then discarded once you "learn to fly".

In short, most instructors teach checklists as a "do list" -- do this, so that happens -- instead of what it really is designed for, to check you haven't forgotten something as a result of inexperience or workload. Using printed cards as a "do" list is a sure fire way to stop using them at all.

Checklists do, however, have great value in all phases of flight. But we have to use them correctly. Establish a flight condition or attitude from memory, but then as time permits, pull out the printed checklist and check that you didn't forget something.

Instead of using printed checklists, some instructors teach diligent use of mnemonics, or memorized checklists. Used consistently these are excellent checklists in their own right. *FLYING LESSONS* recently asked readers to send in some of the mnemonics they use. This week we got these responses:

Aerobatics instructor Tony Johnstone:

> You know my preference for the old Royal Air Force pretakeoff checklist I learned from my dad, TMPFFGG:
>
> Trim
>
> Mixture
>
> Pitch (Prop)
>
> Fuel (Tank/Quantity/Boost Pumps)
>
> Flaps
>
> Gills (Cowl Flaps)
>
> Gyros

Worked well in 1943, still works for any piston airplane today, you'll never forget anything that might kill you. I do it before EVERY takeoff.

Instructor Ken Rogers relates his checklist for leaving the airplane after flight:

MIDGET:

Master off

Ignition

Doors locked

Gust lock installed

ELT is off

Tie the plane down

Ken also sent his Emergency ABCs:

Air speed

Best Field

Check Systems (attempt restart)

Declare Emergency

Exit airplane

I teach this mnemonic to use upon clearing the runway after landing: FLATS:

F **F**laps UP

Cowl **F**laps OPEN

L **L**ights AS REQUIRED (landing light off, strobes off, taxi light on)

A **A**vionics TRANSPONDER TO STANDBY or as required

T **T**rim SET FOR THE NEXT TAKEOFF

Time noted AS REQUIRED (some turbocharged airplanes have a shutdown time limitation; time may be needed for closing a flight plan or other purposes)

S **S**witches AS REQUIRED (Anti-ice/de-ice off, etc.)

You may have a "clean-up" mnemonic or printed checklist you prefer.

Once past the hold line or otherwise clear of the landing zone, stop briefly, go through your after-landing check, then call Ground if appropriate or otherwise begin your taxi to parking or back for another takeoff. Of course we must also maintain vigilance to avoid taxiing into anything, regardless of the flap position during taxi.

Airlines developed the cockpit flow as a means of quickly accomplishing proper actions in a complex aircraft at times when, even as a crew, there might not be time to run through a printed checklist. A cockpit flow is simply a practiced way of looking around (for instance, left to right, or through steps of a memorized checklist) to make certain everything's set the way you expect. Flows are a memory aid, which of course is the goal of all checklists. Cockpit flows also work well to verify what you did from memory is what you think you did, and that the airplane is properly configured for whatever comes next—a checklist.

Best use of a checklist comes in concert with flows and mnemonics. You should:

- Configure the cockpit for the desired flight activity from experience and memory, including use of mnemonics;
- Cross-check with a practiced flow pattern to confirm everything is where you think it should be; then
- As time permits, reference a printed checklist to make certain you didn't overlook or forget something.

For more see my article Leading Edge #4: Checklists and Flows, on AVweb.
www.avweb.com/news/leadingedge/leading_edge_checklists_and_flows_194990-1.html

Questions? Comments? More mnemonics to share? Let us know, at mastery.flight.training@cox.net

Debrief: Readers write about recent *FLYING LESSONS:*

Reader Jay Graph suggests some recommended reading by another *FLYING LESSONS* reader. Jay writes:

> **Regarding** new-engine risk management protocol, there was an interesting article by Mike Busch titled, "The Waddington Effect" in the March 2011 issue of EAA Sport Aviation magazine. It concerns Reliability-Centered Maintenance (RCM) during an airplane's entire lifetime, and suggests that some of the mandated maintenance actually makes flying less safe. Scheduled maintenance tends to increase breakdowns. Perhaps we should do less maintenance. I'd encourage anyone interested in this subject to read the article. Very illuminating.

See:
http://www.sportaviationonline.org/sportaviation/201001/?pg=90#pg90
http://forums.savvyaviator.com/articles.html

Reliability Centered Maintenance (RCM) is

> …a process to ensure that assets continue to do what their users require in their present operating context. It is generally used to achieve improvements in fields such as the establishment of safe minimum levels of maintenance, changes to operating procedures and strategies and the establishment of capital maintenance regimes and plans…. Reliability centered maintenance is an engineering framework that enables the definition of a complete maintenance regime. It regards maintenance as the means to maintain the functions a user may require of machinery in a defined operating context.
>
> In the early 1960s, with FAA approval the airlines began to conduct a series of intensive engineering studies on in-service aircraft. The studies proved that the fundamental assumption of design engineers and maintenance planners—that every airplane and every major component in the airplane (such as its engines) had a specific "lifetime" of reliable service, after which it had to be replaced (or overhauled) in order to prevent failures—was wrong in nearly every specific example in a complex modern jet airliner.

(Although I do not like to cite Wikipedia as a source, this particular entry contains a great many authoritative citations so instead of repeating them all here I'll invite readers to see the list here.)

See http://en.wikipedia.org/wiki/Reliability_centered_maintenance.

Thanks, Jay. Mike's EAA article is actually an update of one he did for American Bonanza Society magazine several years ago, based on his even earlier work on AVweb. It is very eye-opening and I agree with Mike's premise.

I've found, however, that many airplane owners use the concept of RCM to defer maintenance and overhaul indefinitely for financial reasons only, without consideration for the need for enhanced inspection or consequences of failure. For example, pilots have a horrific record when faced with partial panel flight. Although it's tempting to fly until failure with vacuum or instrument air pressure systems, the consequences of failure are such that we should not defer scheduled overhaul or replacement of instrument-driving pneumatic pumps. In another example, Mike's turbocharged Cessna 310's engines are far beyond their recommended TBO, but he continues to fly them in part because he does a complete borescope check of all cylinders (I believe every 25 hours)—extending the engines' lives by *increasing* the scrutiny, so he can make an informed decision about replacement or overhaul. The fact that his airplane has a second engine, and that he attends simulator-based training at least twice a year to keep his engine-out skills sharp (another place where he doesn't skimp on costs), are also factors that make it less risky to exceed the manufacturer's recommended TBO.

From my conversations with Mike I believe he is keenly aware that some readers mistake his meaning and choose to postpone necessary repairs or replacements because of a mis-read of the RCM concept as saying simply "you don't have to spend money because RCM says so." But if an airplane owner is willing to increase the depth and frequency of inspections (i.e., spend *more* money), then moving past manufacturer's recommended overhaul schedules may be done safely.

Jay replied:

> I agree whole-downheartedly agree that not doing maintenance solely for the purpose of "saving" money is not a wise idea. However, doing mandated-but-actually-unnecessary maintenance is equally unwise. Although I have little experience in the aviation world (I'm up to a whopping 35 hours now!), there are two similar activities which I think are analogous.
>
> First, medicine. There's the saying that the best way to stay healthy is to stay out of the healthcare system. The headlines are full of cases of people who went into the hospital for optional work, only to catch an infection from some bacteria that is drug-resistant.
>
> Second, automotive repair. I used to have a Mustang that came out of the shop looking different than when it went in. Inevitably one of the cables or hoses would be routed differently than before. Given that there must be only one best (designed) way, by definition most of the time the car was reassembled incorrectly. Nowadays I still have the required and obvious maintenance done (e.g. oil changes), but never any optional work that involved tearing things apart. Not to save money, but to prevent somebody from inadvertently breaking something that isn't broke. And that is what I think RCM and the Waddington Effect is about.

Perhaps you're right. We agree that replacing or overhauling solely on the basis of arbitrary times in service is costly and in many cases unnecessary. Note that most overhaul requirements, though, are based on engineering done by the manufacturer. Very frequently after a new product enters service--a new engine design, for example--the TBO is set low but then increases as the product line demonstrates operation in the fleet. The same commonly occurs with airframe life limits for FAR 23-certified airframes.

Since in general aviation there is usually far less frequent operation than in airline service, however, corrosion and failed seals in components are much more likely to cause the need for overhaul or replacement than simple wear. It takes inspection beyond the minimum requirement of the FARs to detect these problems is an airplane owner is to avoid replacement based on recommended time in service alone.

Your medical and automotive examples demonstrate the valid concern for getting good maintenance and repair by someone who is an expert in the make and model. But in the same fields it's generally accepted that best results come from increasing the frequency of physical exams to catch incipient cancers and other issues as we age, and to undergo more invasive inspections like colonoscopies. And long engine life in a car's engine is usually tied to more frequent oil and filter changes and an occasional diagnostic trip to the shop. My point is that we practice RCM in our bodies and our cars as they incur greater fatigue exposure ("age") by inspecting and servicing them more frequently and in greater depth.

RCM as introduced and adopted by the military and the airlines, and as Mike Busch wisely suggests be adapted to general aviation operations, isn't about avoiding mechanic error. It's about using data on historic failure rates to fly equipment through the end of an individual component's useful life and catching it just before the point of failure. The idea is to eliminate arbitrary replacement and overhauls in favor of data- and inspection-driven decisions. To do so requires an increase in inspection frequency and focus as items like cylinders and instrument air systems build time in service. Perhaps Mike will chime in with some additional insights (or to tell me I'm bogus) in *FLYING LESSONS*.

Thanks! It's great to have fresh minds in aviation!

Frequent Debriefer David Heberling addresses last week's theme of failures at the "low end" of the time-in-service spectrum:

> Let me relate my own experience with an infant engine that died most definitively at a most inopportune time. In the late '70s when I was still teaching, I was getting two CFI students ready for their check rides. Our airplane for the flight was a Piper Arrow I. It had had a recent overhaul on the engine done about 150 hours before the incident. The overhaul was done by our own mechanics who worked in our shop.
>
> To begin the flight, we departed to the south and practiced emergency procedures. I was sitting in the [left] seat, one of the students was the acting CFI-to-be in the right seat with the other student in one of the back seats. We came back into the pattern to practice short field take offs and landings on runway 25. The first landing was followed by a touch-and-go with the intent to make the "go" portion a short field take off over a 50 foot obstacle. Just as we were passing the control tower (off to our left), we raised the landing gear and pulled the power back to 25" square. The engine immediately started to make some grinding noises. I immediately took command and pushed the nose down to make a dog-leg base to short final on the remaining portion of runway 22 in front of us. As soon as I had done that, we heard a loud "bang" and oil poured out all over the windshield. I could not see anything out of the windshield.
>
> I had to make do with looking to the side out of my side window. I lowered the gear and shut the fuel off. As we were nearing the ground, the airplane started to roll to the left. I pushed right rudder and flared. We ended up touching down in the grass between runway 22 and taxiway "A". The ground roll was very short and we stayed in the grass. When we finally got out of the airplane we were eager to inspect the engine area. There was no evidence of any problem on the right side. On the left side of the cowl all evidence of what had happened was in full display. There was a hole in the cowl with a piston sticking out of it. The cylinder head was gone.
>
> It took me years to find out what the probable cause might have been. Given my findings, I never use used parts in an engine rebuild. It turns out our mechanic reused the connecting rod bolts. These bolts are designed to "stretch" somewhat when torqued to the prescribed amount. They were never intended to be reused. I think reusing parts is false economy. The risk is too great that something has been weakened substantially. New parts are no guarantee against sudden failure. However, the best mechanics insist on matching push rods to best fit for each valve, honing valve seats for best fit, flow matching, and other assorted tricks to get a well-balanced engine that runs very smooth. Use only companies that have engine test cells for proper first few hours break-in. Use the recommended oil and procedure for the operation of the engine until the oil use stabilizes. Change the oil according to recommended procedures. Even after oil use has stabilized, change oil on calendar basis if aircraft is not flown enough to use the engine tach time. Engine oil analysis is a must, but also monitor engine parameters closely.
>
> I look forward to other suggestions from your readers on this subject.

Thanks, David. Reader Graeme Lang tells me I've been helpful:

> We have just installed two factory-remanufactured engines on our Navajo. As soon as the maintenance folks were finished with their part this past Monday, we (the pilots) were getting immediate pressure to perform the "break-in" flying so we could accept a paying flight scheduled for today (Thursday). Well, with the remnants of Tropical Storm Lee hanging around all week causing low ceilings and visibility, we made the case to postpone the break-in flight until the weather cleared up (i.e., next week). Our bosses were not very happy. So, I have since copied your "This Week's Lesson" on engine break-in flying to them so they could have even a better idea of what is involved. I thank you for this and, as always, I really enjoy reading *FLYING LESSONS*.

Glad to be of service, Graeme. Reader John Townsley continues:

> This topic is timely. Something like 1/5th of accidents have a maintenance root cause. This astounding statistic doesn't get much attention. I do a lot of online courses, as well as attend most seminars offered

> within a reasonable distance. Airspace, landings/takeoffs, maneuvering flight, etc. etc. etc. get a lot of press. I also attend most IA seminars held near my home. I don't recall a single seminar in the past six years that even mentioned the high proportion of aircraft accidents caused by maintenance error. I know it's tough to do without standing next to the mechanics every time the plane is shop bound, but I believe pilots need to be very attentive to maintenance issues. If something isn't right, don't bull ahead. Get it checked out.

You have a very valid point, John. Thank you. We as an industry really focus on the human factors that contribute to around 80% of all accidents—sometimes forgetting, as you've reminded us, that approximately one out of five accidents indeed does have an identifiable, hardware-related cause. Sometimes it's caused by failures of the machines themselves, others because of human factors affecting the builder, mechanic, or installer. I'll try to remember to address maintenance-related mishaps with the frequency that their contribution to the accident record warrants.

Reader Robert Thorson writes:

> Hi, Tom. Two weeks ago a reader suggested "aileron drag" help keep the aircraft on the runway laterally. At first thought it appeared it offered some value but with additional thought and research I was a little concerned.
>
> With primary students a CFI tries to prevent behaviors of "steering" at low speed because it is ineffective and de-emphasizes proper rudder use. Most aircraft flying today have this adverse yaw (the proper term) designed out by some aerodynamic means. The concept that the commenter put forward does shed light on why some loss of control accidents occur at low speed....improper or not full understanding of basic aerodynamics. As some pilots progress to the airlines it is interesting that the same problem of staying on the runway crops up. Using ailerons on an airliner causes more problems due to spoiler interaction and under wing mounted engines.
>
> The principle of primacy is at work here. If the initial hours of primary training are not correct the result can be carried forward for years. It all starts with the first few hours. If the CFI doesn't know... the student will not know and years later an accident occurs. CFI mentoring is the big push now.
>
> Thanks for good work that you do.

Interesting, Robert. I agree that most airplanes have aileron drag engineered out of them, certainly at the low speeds we see on takeoff and landing. Your comments on the greater implications are enlightening. I know that I found evidence of "aileron steering" in a Cessna 120 I once owned and some Cessna 185 taildraggers, but less so in tricycle gear airplanes and especially those I fly that have an aileron/rudder interconnect. As you point out, I've always stressed rudder for directional control on the ground, and proper positioning of the controls for head/tail/ crosswinds. Maybe in doing so I'm applying the correct inputs for aileron steering, or perhaps this makes aileron steering unnecessary. I know the author of the post to which you're responding fairly well (he's a retired airline pilot) and will expect some more reader mail on this subject!

Reader Tim Timmons responds to a reader's suggestion that we have a toll-free number to report unacceptable pilot behavior, similar to drunk-driver numbers in many states:

> I just joined the [*FLYING LESSONS*] mailing list and love the newsletter. Regarding the comment about a 1-800 number, the FAA actually has established a safety hotline for the specific purpose of reporting unsafe acts. The number is 1-800-255-1111.

Welcome aboard, Tim, and thanks for the reminder. Reader Larry Randall tells us there is an online option as well:

> I just read the latest [*FLYING* LESSONS], good as always. A reader suggested a hotline for reporting pilots. It already exists. Go to: www.faa.gov/contact/safety_hotline/. They will take anything and, if warranted, launch an investigation.

Thank you also, Larry. Maybe our many FAA readers of *FLYING LESSONS* can elaborate about experience with these systems, and consider giving us some guidance about how to use them for their intended purpose as well as publicizing the number and website more aggressively.

Readers, tell us what you think, 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