FLYING LESSONS for February 4, 2021

FLYING LESSONS uses recent 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 airplane have little direct bearing on the possible causes of aircraft accidents—but knowing how your airplane's systems respond can make the difference as a scenario unfolds. So apply these *FLYING LESSONS* to the specific 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:

Once again our readers' insights are worthy of a dedicated Debrief issue. Let's go straight to it.

Questions? Comments? Experiences to relate? Send them to mastery.flight.training@cox.net.

Debrief: Readers write about recent *FLYING LESSONS:*

Several readers responded to last week's *LESSONS* derived from a U.S. Air Force E-11A accident report. Glenn Shreiner writes:

> I just finished reading your *LESSON* on the E-11 accident. I do not disagree with anything you stated or inferred. I've known the Pilot in Command [name withheld] since he was about 14 years old. Our families were friends (and still are) and I used to take him flying around central Florida...he truly had a passion for aviation. If there was an airshow within 500 miles, he was hitting me up to take him. We kept in touch over the years and we were actually stationed together at Columbus AFB, he as a T-1 IP [instructor pilot] and I as the Chief Air Traffic Controller. My only regret with the entire incident is that his legacy is overshadowed by his mistakes. [He] was an outstanding man/husband/father/friend.
>
> Keep up with the great article writing. I love seeing them pop up on my email.

I replied: That **is** very regrettable. I always try to remember **there are real people involved**. Thanks for letting me know. If you'd like me to include your note as a reminder of that for us all, with or without his name, please let me know.

Glenn responded:

> I think it would be nice to add the note without his name on it. If people are curious as to who he is, they can easily look it up for themselves. Thanks again for all the articles that are put out. Knowledge is power.

Thank you, Glenn. I'm very sorry about your friend.

See https://www.mastery-flight-training.com/20210128-flying-lessons.pdf

Frequent Debriefer Chris Ceplecha adds:

> Excellent article with regards to engine failure.
>
> After reading it, I was very puzzled by this particular event. Just ***how could a professional aircrew shut down the wrong engine?*** I had a hard time understanding it. So, I dug into the actual USAF AIB report, which is available to all. **27 Jan 2020 - ACC - Bagram Airfield - E-11 - AIB Narrative.pdf.** The report was a bit surprising.
>
> Viewing the EICAS display, (you can look at it within the accident report) it is not readily apparent which engine has failed. Apparently, AFTER the left engine failed, the left engine has an EPR reading of 1.64 and right engine EPR was 1.52. The left engine N1 was 92.4% RPM and right engine N1 was 87.6% RPM. Finally, left engine ITT was 753 degrees C while right engine ITT was 720 degrees C. Combine this with the fact the aircraft was at 42,000 feet MSL climbing to 43,000, where thrust output is greatly reduced, **the actual failed engine may not have been readily apparent**. According to the accident board report, the level of vibration was significant, and the aircraft was moving in both the X and Y axes (pitch and yaw).
>
> So, while the initial gut reaction is to say, "how could they have gotten this wrong", after reading this accident report I come to a different conclusion, and that is,,,,**lack of realistic training** for engine failure.
>
> Just how to do verify which engine has failed? In most cases, it is readily apparent, due to yaw, engine indications, performance, instrument readouts, etc. But in this case, at least according to previous similar incidents and the accident board, the aircraft was yawing and pitching in both X and Y axes, and EICAS indications were confusing, to say the least.
>
> The point I am trying to make is that ***in many cases, emergency training is very type specific in nature***. In order to perform properly in the event of an engine failure, **one needs to tap into the corporate knowledge of the community** to ensure you have the best chances for a successful outcome. In the case of this aircrew, it almost seems like they really had a series of cockpit indications that were not conducive to proper diagnosis of the problem. **That leads us back to the old saying, "*wind the clock*" in the event of an emergency**. **In very few cases is there a need to do something RIGHT NOW.** There is almost always enough time to properly analyze and confirm what the problem is prior to taking actions that in many cases are irreversible.
>
> The sad thing is that the aircrew really did not *have* to do anything for a very long time. This aircraft has excessive amounts of power in a single engine failure mode, and they could have taken a lot longer than 20 seconds to figure it out. They were at 42,000 ft MSL only 17 miles from a suitable field, with plenty of options.
>
> Finally, **talk to the seasoned pros in your airframe type**. What do they use to "verify" which engine has failed? And how do they verify the verification? Do they use lack of fuel flow, lack of EGT, lack of manifold pressure response to throttle movement, adverse yaw towards the failed engine, yaw direction of the nose, or what? What works best to "verify" in your specific aircraft? Try it out in a simulator and establish what you will do.
>
> I predict there will be a change in training in this particular aircraft with regards to engine failure.

Your point is why I used this tragedy as an example in a *LESSON* aimed primarily at pilots of far less sophisticated airplanes: to highlight the need to know the indications of engine failure in the airplane you fly, and more importantly, to discuss how **the *pace* of your response to an emergency condition is as important as your actions in that response**. Thanks, Chris.

See https://www.acc.af.mil/Portals/92/AIB/27%20Jan%202020%20-%20ACC%20-%20Bagram%20Airfield%20-%20E-11%20-%20AIB%20Narrative.pdf?ver=JTtqv010mUgW_zSaqrJjnw%3d%3d

Reader Sam Dawson continues:

> I had some of the same thoughts when reading about the E-11A crash. I'm loath to criticize the pilots when the full results aren't known, but we do know they shut down the incorrect engine.
>
> I was a military instructor pilot on active duty, then transitioned to the National Guard when I went to fly for the airlines. I was struck by the difference between emergency procedure training in the military versus the airlines. While **in the military we were taught to react immediately to an emergency, in the airlines we were taught to be slow and methodical—better to do *nothing* than to do something wrong.**
>
> In the military, I saw two glaring examples of how this could cause issues. In the first case, I was giving aircraft-specific training to an experienced pilot. I was flying and demonstrating when we got a spurious fire light. Before I could react, the other pilot pulled the fire handle for the ***good*** engine. (Sound familiar?) No confirmation from me, he just pulled the fire handle. Fortunately, he did not blow the fire bottle, the fire light

> was false and went out on its own after about five seconds, and we were able to start the engine that was shut down.
>
> In the second example, while I downwind at an airfield at night I gave a pilot a simulated fire by pushing the fire test. I announced it first as "simulated", and this was an approved procedure. The pilot immediately reduced power and started to land straight ahead. I asked what he was doing and he responded "Landing as soon as possible." I pointed out my window at an airfield with crash rescue, but he responded that "Land as soon as possible means land immediately. That's right here." It didn't matter that landing in the desert would probably result in the destruction of the aircraft and possibly our demise, he would follow procedures.
>
> Compare this to the airline training. In the simulator we have it hammered into us, ***fly the airplane first*** **and take your time**. It's even printed on both sides of our QRH [checklist] in bold letters. We are taught that both pilots must visually confirm a thrust lever, fuel lever, and fire handle before one is pulled. Even if there is a fire we don't act "immediately". We are taught to **take our time, be methodical, and do it right the first time**. If an engine catches fire immediately after takeoff, we are taught to climb to a safe altitude before running the checklist. If on final, it's even acceptable to wait until landing before doing so.
>
> In my final years as an IP [military instructor pilot] I tried to counter the military culture, but it was a quixotic fight. The normal response was that I was trying to apply airline procedures to the military. No one thought the military could learn from the mistakes the airlines had already paid for in blood. It seems, unfortunately, this may still be the case.

Of the two approaches above I fall into the "airline" model—take your time and do the right thing. An example: I took my ATP (Airline Transport Pilot) checkride in a Beech Baron at Farmington, New Mexico about 20 years ago. On the last approach of the checkride the examiner simulated an engine failure just before I reached the Final Approach Fix (FAF) on an ILS approach.

Having spent (at that point) a decade studying Beech accidents and working on techniques for reducing pilot workload, especially in emergencies (including writing two editions of my second book, *Cockpit Resource Management: The Private Pilot's Guide*, which is out of print and in sore need of a major update), I identified and verified the ailed engine and simulated feathering the correct propeller—the examiner adjusted throttle and prop controls into "zero thrust." I then "contacted" Air Traffic Control—the examiner was playing that role—simulated declaring an emergency and advised I was going to maintain my current altitude, proceed straight ahead, and let them know when I was ready for vectors for a single-engine approach. We did just that and I completed the checkride with a simulated engine-out ILS and landing.

In my checkride debriefing the examiner congratulated me on my performance but provided this one criticism: "You're an ATP now. You should have continued with the approach and taken care of the engine failure on the way down the approach." I still feel that I did the right thing. Thanks, Sam.

See https://www.thriftbooks.com/w/cockpit-resource-management_thomas-p-turner/727496/item/42227021/?mkwid=%7cdc&pcrid=474991465905&pkw=&pmt=&slid=&plc=&pgrid=111207720959&ptaid=pla-1041658227247&gclid=CjwKCAiAsOmABhAwEiwAEBR0ZmO0OZEbWB9k2rlQNRRopB1CXSKtOjRsQ4UK3HrsSQMgqXR7BCg-XBoC350QAvD_BwE#idig=42227021&edition=57925461

A few days later Sam Dawson wrote again:

> …and still another one. The exact same thing happened to a UH-60 in another unit when I was deployed. They were hover taxiing at Tallil Air Base in Iraq when an engine started to fail. It was producing some power but was failing. The runway was right next to the aircraft. Rather than sliding over, landing, then diagnosing the problem the IP (instructor pilot) instinctively reached up and shut down the engine. But he didn't confirm the engine and shut down the wrong one. The helicopter descended into the ground, hit a berm, and flipped over, destroying the aircraft and seriously injuring the crew chief.
>
> **We haven't discovered new ways to destroy aircraft. We just keep doing it the same way.**

That's what keeps me going with *FLYING LESSONS* nearly every week, Sam—pointing out the relatively few things we need to do to substantially reduce the number and rate of mishaps. Thanks again.

See https://www.ainonline.com/aviation-news/general-aviation/2021-02-02/wrong-engine-shutdown-triggers-helicopter-fatal

A reader who wishes to remain anonymous gives further technical insights that partially exonerate the E-11A crew, or at least better explain their actions:

> Technically, this wasn't an "uncontained failure" but rather a "Flan Blade Off (FBO)" event. This is a certification demonstration requirement - they usually use an explosive charge at the fan base and blow a single fan blade off. Further, this must be shown to NOT BE uncontained and result in a more catastrophic event. In other words, not preventing "continued safe flight and landing" following FBO.
>
> With that, we can do some further armchair quarterbacking as, unfortunately, the investigation falls short on more detailed human factors analysis; simplifying to ***startle*** **and** ***reflex***. I would guess the investigation board had not lived through a chug/stall and the resulting magnitude of the impulse and vibrations. The 2006 event crew thought they had a midair - that was also my experience. The investigation determined this event was 25% more severe! **I might speculate that they thought the airplane was coming apart, prompting the perceived necessity for action NOW**. The PIC was no slouch with tons of experience, but the SIC was probably less help with low time on type. With the high vibration levels, reading the engine instruments would have been challenging (think turbulence encounter). And, **24 seconds is an eternity when you're in extremis and as such, the crew alerting needs to be immediate and unambiguous**. Initially, the crew was apparently only provided a L FADEC FAIL amber EICAS message which could mean a variety of things. Typical convention for failures-of-consequence is to alert with a red message. By design, the FBO is likely to take out N1 probes and precipitate a FADEC commanded shutdown - absent timely FAIL crew alerting!
>
> As I understand the integration, **an engine failure wasn't annunciated until RPM decayed - a period of time (under duress) that contributed to confusion and opportunity for misdiagnosis**. Unfortunately, we'll never know why they couldn't restart the "good engine" that they inadvertently shut down, as they had plenty of time to do so - something must have been going horribly wrong. Bottom line, ***this should not have resulted in a catastrophic event, and yet it did***. Writing this off as another "crew failure" feeds inaction to assess the adequacy of our systems coupled with spectrum of potential crew interactions (similar to 737MAX). My suggestion is to adopt a systems theoretic approach to accident causation. Lots of literature on this topic can be viewed at **http://psas.scripts.mit.edu/home/**.

Sadly, technology doesn't always mean an improvement in situational awareness and accident avoidance. It becomes yet another complex system we need to learn and manage. Thanks, reader.

Reader David Tucker tells us this is not the first time this type of accident has happened:

> There's nothing new in accident causation. The notorious Kegworth accident in the UK in 1989 resulted from the pilots hurriedly shutting down the wrong engine then failing to properly review their actions. The official report at pages 97 to 109 contains detailed criticism of their actions. Keep up the good work.

Thanks for the historical context, David.

See:
https://en.wikipedia.org/wiki/Kegworth_air_disaster
https://assets.publishing.service.gov.uk/media/5422fefeed915d13710009ed/4-1990_G-OBME.pdf

> And reader John Watts adds:
>
> First, I'm a new subscriber and am thoroughly enjoying *FLYING LESSONS*. Thank you for providing this outstanding resource! I have a personal example of rushing through an emergency checklist, as described in the **Deliberate Speed** article:
>
> I was a US Army Aviator in the 1990s flying AH-64 Apaches. During a training session in the Combat Mission Simulator (which was full visual, multi-axis and pretty realistic) we lost an engine due to enemy fire. I was flying and was threading my way back to friendly territory on one engine when the instructor caused an engine fire warning light for the remaining operating engine. ***I acted on reflex*** **without going through a checklist**, and without conferring with the co-pilot (although I announced the engine fire), **and immediately pulled the fire pull-handle**. Of course, this shut off the fuel to the operating engine. We were still low, flying tactically, so we were down and it was all over in a few seconds. The only remaining sound was the instructor chuckling over the intercom.
>
> **This drove home the importance of acting thoughtfully and deliberately, and using the checklists** and working together as a team, **even (or** ***especially*****) in a task-saturated situation where time is critical**. Maybe the engine that was on fire would have held out long enough for me to find a suitable site to make an emergency landing…or even longer. I don't know, but I never gave it a chance. I have to believe that if we had taken just a few seconds to discuss it then we would not have shut down the operating engine immediately, and we would have increased our odds of survival.
>
> That was a long time ago, but I still remember the instructor laughing….and the *FLYING LESSONS*!

Great story, John…and another *LESSON* for us all. Welcome aboard the weekly reports.

Frequent Debriefer and retired airline pilot John Whitehead writes:

> I applaud your proffer to **sit in the airplane, no engine running, and go through procedures**. Inflight, the airplane can be a terrible classroom due to all the various distractions. And regarding going through procedures on the ground…do it again next week. Repetition is one of the ways we learn.
>
> Some thoughts not specific to the Cessna 172 [used as an example last week]. Regarding the position of the fuel selector, one of the reasons to change tanks (if the airplane has multiple tanks) is to resolve a situation where the selector isn't initially in a positive detent for a specific tank. Visually, ***it may appear so when in fact it isn't***. If you own the airplane, make sure your fuel selector works as advertised which includes a positive, tactile detent for tank selection. If this is not so, get it fixed. If you rent the airplane, be vigilant with fuel tank selection.
>
> Ensuring the mixture is full rich is appropriate in just about all our GA piston airplanes… INITIALLY. Yes, you need fuel, air and spark to make combustion. But those components will only produce combustion within a proper ratio band. Since we don't know why the engine quit, of course you'll follow the checklist but as you encouraged … "what result should you expect from a specific action?" **Consider a moderately paced "sweep" of the mixture (from full rich to an obviously lean position of the knob) and back towards full rich again**. Such a sweep might even be appropriate for the throttle as well. Somewhere, you might discover a position of the engine controls where some or all power returns. There are sometimes certain engine control positions that could allow partial power where none was available at the original cruise settings. It just depends on what the cause of the failure is. In the end, you still have to multitask. Futzing around with engine controls is appropriate up to a point but you still have to remember, **job #1 is…*fly the airplane***.

Absolutely, John. Thank you.

Flight instructor and one-time Director of Safety for Trans World Airlines Wally Moran brings this back to the cockpits most of us fly:

> I have experienced more than one occasion of the pilot shutting down the wrong engine during multiengine flight tests. While the test itself is a stressor, so would an uncontained failure of a jet engine. A phrase I like to use during these stressed and busy times is to **"make haste…slowly."**

That's the *LESSON*, Wally. Thanks for reinforcing it with your experience.

Questions? Comments? Send them to mastery.flight.training@cox.net.

"The great success of *FLYING LESSONS Weekly* is rooted in how often you do the right thing in encouraging all of us to fly safely and showing us ways to do so." – Bruce Dickerson

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