FLYING LESSONS for September 9, 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 in your success as the 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:

Second-level hazards

I was flying an A36 Bonanza from Council Bluffs, Iowa to Wichita with my wife in the "business class" cabin in back. We were returning after a great Labor Day weekend visiting our two-year-old granddaughter (and her parents). The sky was hot and hazy but clear as we neared the end of the hour-and-a-half flight, soon to descend from our 8000-foot cruise altitude.

The first anomaly I'd noticed, soon after leveling into cruise flight, was that the four-year-old digital autopilot kept disengaging. I set it before leaning the mixture and it flew fine for maybe 20 minutes, but then it tripped off, annunciators flashing and alarm chiming loudly. I let it sit a moment, holding heading and altitude manually with the ease of the flight director that remained operational. Scanning the engine and systems displays on the glass-panel display all looked fine. I reengaged the autopilot.

It kicked off again after maybe three minutes. Taking over manually again, I pulled the autopilot circuit breaker, let it sit a minute or so then reset the breaker—my purpose, to remove power and restart the autopilot in its start-up configuration, so I could activate its preflight test function. It tested fine…but a few minutes later it chimed offline yet again.

The autopilot had behaved similarly a year or so ago, and the avionics shop found and replaced a failed roll servo. I figured this had happened again. Oh well, it's not like I had to fly an approach to about two miles from landing as I had on the way up. Even it if was, I practice hand-flying approaches in the airplane and monthly on a Flight Training Device at the local FBO. I'd land and call the avionics shop then next day after the end of the long holiday weekend.

Kansas City Center handed me off to Wichita Approach. Checking in, adding that I had the destination airport weather, the new controller directed me to descend to 4000 feet. I set the altitude bug, throttled back four inches of manifold pressure to descend at 500 feet per minute at my cruise indicated airspeed, and began my descent.

But then I noticed a new indication. The alternator load was still at zero, indicating the battery was being maintained, but the bus voltage—normally and up to a few minutes before reading 28.5 volts—was reading 25.7. The battery is rated at 24 volts, so the system was charging *a little*. But clearly the electrical system wasn't functioning normally.

Maybe the autopilot is sensitive to small changes in voltage, and the malfunction was intermittent. Perhaps each time the electrical fault occurred I was distracted by the autopilot

annunciators and alarm; by the time I returned to my normal scan that includes the ammeter and bus voltage (well-placed immediately adjacent to the Primary Flight Display) the fault had cleared and the voltage had returned to normal.

But now it appeared there was a hard fault, not a total failure but enough to potentially impact operation.

This vintage of Bonanza has an Alternator Out light. It was not illuminated, but it *had* worked when I tested the annunciators on my Before Takeoff checklist. However, that made sense. The annunciator lights up when the alternator load is "near zero," according to the Pilot's Operating Handbook. It also illuminates in an overvoltage condition, but that was not what was happening now.

This airplane also has an aftermarket standby alternator. By design and checklist it is turned on for normal operation so it will take over if the primary alternator fails. The backup is only rated at 20 amps, so although I didn't think I was using a lot of electricity, just maybe the standby was just barely keeping up. ***Yes,*** I thought, I might indeed have a primary alternator failure…or one other possibility.

All seemed well, but historically there are two hazards—both serious, one extremely so—associated with a reduction in system voltage in this make and model of aircraft:

1. **Landing gear collapse during the landing roll.** The Bonanza's landing gear operates electrically. It requires full system voltage to work correctly...in some cases the gear may extend far enough to illuminate the "down" lights but not quite far enough to lock down. Every year I read several accident reports that begin with "the pilot reported electrical problems" and end with "the landing gear collapsed on the runway."
2. **Catastrophic engine failure in flight.** The primary alternator on this airplane type is gear-driven through a set of gears between the alternator and the engine crankshaft. If the alternator seizes up causing or as a result of alternator failure, it can (and at times has) sheared the drive gears, sending metal shards into the engine that cause engine failure.

The second hazard is unlikely, especially in later alternators (like the one on this airplane) that have a newer-design drive coupling that virtually eliminates this threat. Still, when Approach directed me to descend to 3000 feet I instead cancelled my instrument clearance and held altitude until I was closer to the airport.

The first hazard is more likely, and is mitigated by using available electrical power to extend the gear, then using the manual landing gear extension procedure to hand-crank the gear to ensure it is locked fully down. I did this higher and farther from the airport than a normal gear extension, pulling the breaker per the abnormal procedures checklist and reaching behind the seat to turn the hand crank. It went a bit more than half a turn before it would turn no further…exactly to specifications, telling me it was indeed locked down. But it was definitely worth checking.

I'm not writing this to boast. Instead, I hope it inspires you to learn more about your airplane's systems. I draw two *LESSONS* from my experience this week:

1. Above all, as always, ***fly the airplane***. There were ample distractions, but I remained focused. This was a good test of my ability to hold altitude and navigation while dealing with a series of status changes. It's good to be tested occasionally—and pass.
2. The bigger *LESSON* for readers, however, is to **know your airplane's systems *and* the potential second-level impact of failure modes**. Often the real hazard of malfunctions is not the initial failure itself, but the secondary results of those failures.

How can you know those second-level hazards?

- **Read Section VII, Systems Description, of the Pilot's Operating Handbook.** Most won't tell you everything, but you'll still gain a greater understanding of how systems are designed and what triggers which warnings. Many POHs have detailed electrical and other diagrams that permit you to see how systems interact with one another. Section VII also contains many notes, warnings and cautions that may suggest possible second-level hazards.
- **Read the Emergency Procedures** section as well, not just the checklists but also any notes and expanded procedures descriptions.
- **Review the Normal Procedures and Limitations** sections while you're at it.
- **Ask your mechanic and flight instructors** if they have any advice about secondary failure modes. Much of this information is, unfortunately, not written down in the manuals. Technicians and instructors may have personal experience or have heard stories.
- **Participate in users' groups** for the airplane type. This is where the real cultural wisdom resides. Type clubs, internet discussion boards, anywhere pilots and mechanics share information is a place you can learn more about your aircraft.
- **Read accident reports and look for trends.** For example, I found the correlation between inflight alternator failure and subsequent gear collapse over years of publishing my Beech Weekly Accident Update. You might fly a different airplane type, but if there's no one tracking trends for the type you fly you can read the daily FAA mishap reports and the NTSB preliminary and Probable Cause reports yourself to detect patterns that might suggest mitigations for the secondary effects of systems malfunctions.

See:
http://www.mastery-flight-training.com/beech-weekly-accident-updat-2.html
https://www.faa.gov/data_research/accident_incident/preliminary_data/
https://www.ntsb.gov/_layouts/ntsb.aviation/month.aspx

Oh, yeah. The other failure possibility I considered? It may not have been an alternator failure, it may have been a bad voltage regulator. As it turns out that's what my mechanic found—the original 1981 unit only lasted 40 years. At least when it did, I was ready.

You can—and should—be ready too.

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

Debrief: Readers write about recent *FLYING LESSONS:*

Reader Larry Slade comments on last week's *LESSONS* about thunderstorm avoidance:

> Two points about thunderstorms and radar: ***First*** is that through an embarrassing number of airplanes and panel upgrades I've always held on to a StormScope. I've learned to **not go where the dots are**. Conversely, it's been my experience that **you can go through green and some yellow smoothly if the scope is clear**. I take note of your point about green with yellow in it and will approach this more cautiously.
>
> My ***second*** point is that the presentation can be quite different depending on the device. Often the iPad , in my case with ForeFlight, will show a more benign picture than the Garmin screens. One is tempted to

> believe the one that looks the best. Of course, the best of all is when you have that third option, radar in the nose.

That's an extremely important point, Larry. **There is no standard for the colors used to indicate the intensity of radar returns**—what is green on some displays will appear yellow on others; red returns will be magenta on other devices. What's more important is knowing the indicated decibel levels of precipitation returns on whatever devices you're using. Where as you said it's tempting to accept the radar picture that looks the best, when comparing multiple displays it's more important that you **heed the radar image that looks *worse***. Thanks, Larry.

See http://www.mastery-flight-training.com/20210902-flying-lessons.pdf

Reader John Majane continues last week's Debrief discussion about airspeed and angle of attack control during an approach or a go-around:

> On getting slow on final in any plane this is where proper use of trim comes into play. ***If the plane is trimmed for an airspeed you don't have to constantly refer to the airspeed indicator. You will know if you are pushing you are too fast, and pulling too slow.*** You also won't need a death grip on the control which will just create more work when the less is better.

Excellent point, John. Thank you.

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