Squawk This!

ISTOCK

Making **effective** maintenance write-ups

BY **JAMES ALBRIGHT** james@code7700.com

An early initiation for most pilots includes the humor of poorly written maintenance write-ups, or "squawks." We all laugh about the nonsensical pilot entries made on the left side of an aircraft's maintenance log destined to be corrected by a funnier mechanic's entry on the right.

Even when flying the simplest single-engine trainer, we pilots understand a mechanic will need more than just a terse "it's broken" write-up. But once the flying is done, our pilot personas transition seamlessly to whatever else that interests us and the mechanic is left with a bit of detective work. Much of a mechanic's troubleshooting is handicapped, since he or she cannot re-create the conditions of the problem during flight. Our efforts to capture the problem with written words can also be handicapped just a few hours after the

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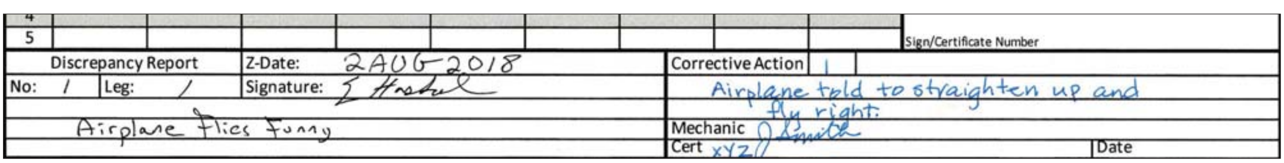
Maintaining an airplane to the standards of a licensed airframe & powerplant mechanic involves more than just "turning wrenches"



5
Sign/Certificate Number
Discrepancy Report
Z-Date: 2AUG2018
Corrective Action
No: 1 Leg: 1
Signature:
Airplane told to straighten up and fly right.
Airplane flies funny
Mechanic
Cert XYZ
Date

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Discrepancy: **Airplane handles funny.**
Corrective Action: **Aircraft warned to straighten up, fly right.**

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Many airplanes will self-diagnose and report the trouble. An unsuspecting pilot may think this is the root cause, but it may in fact just be the first step of many in the troubleshooting adventure.

event. Let's say that the engine coughed after a sudden power change halfway through the flight. Knowing the altitude, power settings and flight conditions can help a good mechanic narrow the search. But if you don't remember those after you land, the problem may have to go unsolved until the next flight.

As we progress from renting airplanes to flying professionally, the complexity of the airplanes increases as does the likelihood that we will have a squawk or two following a flight. If the airplane becomes more complex for the pilot, you can imagine that the task confronting the mechanic has increased as well. If you aren't providing your technicians with complete and accurate write-ups, you are setting everyone up for failure.

You might wonder why any write-up from the pilot is needed at all in these days of computerized airplanes. Many business jets are equipped with a central maintenance computer (CMC), maintenance diagnostic computer (MDC), or something equivalent that monitors the health of the airplane full time. Some airplanes send text messages to home base periodically while in flight and upload reams of information via wireless connections as soon as the airplane pulls into its own hangar. With this level of technology, does a pilot squawk provide any additional, meaningful information?

It has been my experience that a computerized diagnostic health system can be of great help or it can lead a mechanic down the rabbit hole. Many of my Gulfstream G450's systems have multiple layers of redundancies and when one lane of one channel of a certain system becomes unhappy, another lane of another channel quickly takes over. The computerized tattletale can spit out reams of squawks that lead to multiple dead ends. A pilot's squawk could add the needed context if it includes as much information as possible about what was happening at the time.

While a mysterious fault code could lead your technician to the right black box to test or replace, it could also be that the fault in question was triggered by something upstream. For example, we spent several hours tracking down a data-link issue that was really a problem with a VHF radio. Had we remembered the error occurred during coast out over Gander, Newfoundland, our team could have realized it was an issue between our terrestrial and satellite data systems, not the data-link processor itself. But even without the help of onboard computer diagnostics or confusion over fault codes, a pilot's accurate write-up can be the difference between a "no fault found" return to service and a properly repaired airplane.

In one of my flight departments we were plagued by a radar that worked well one day and appeared blind to the weather on the next. Pilot write-ups were usually of the "radar inop" category but sometimes wandered into the "I told you to fix this radar!" territory. No matter the tenor of the squawk, the result was always the same: "No fault found." The aircraft's maintenance computer was as happy with the radar as the pilots were miserable. The issue threatened to tear us apart. It seemed a binary choice: The pilots didn't know how to use the radar, or the mechanics didn't know what they were doing. In a fit of desperation, our mechanics ordered bench-testing gear, pulled the radar, tested it, and gave it a clean bill of health.

We were at an impasse until I flew the airplane on a day when we saw several thunderstorm cells from hundreds of miles away and watched the radar carefully. We discovered the radar had random blind spots. It didn't make any sense because the radar showed the same blind spots no matter which screen we used. So, we pulled the radar and sent it to the manufacturer with a photo of the blind spots. It was only then we discovered that a bank of circuits in the radar's receiver had burned out. The maintenance computer and bench test were oblivious to this because their tests only went as far as the signal processor. In the end we had a repaired radar, but we had wasted a lot of time with incomplete write-ups and frayed a lot of good will between our pilots and mechanics.

The lessons here may seem to be more common sense than anything else. But we pilots tend to lose all common sense when frustrated by an airplane system not behaving as it should. A little professionalism will go a long way in solving this problem, but it is only the first step.

Be Professional: Fly Like a Test Pilot

Some aircraft problems happen suddenly with no warning and the job of the mechanic becomes that of detective work. In many cases this can be as simple as replacing a bulb that has burned out; in others it will be hours of research, swapping parts or educated guessing. There are times, however, where there are signs leading up to the failure. Since the mechanic is rarely with the airplane during a write-up flight, it will be up to the pilot to do the detective work before the failure.

On Aug. 13, 2005, the cabin crew of a Helios Airways Boeing 737 made an entry into the cabin defect log stating that "aft service door seal around door freezes and hard bangs are heard during flight." The flight crew transferred this to the aircraft technical log as "aft service door requires full inspection." That night the maintenance team visually inspected the door and performed

a cabin leak check. The ground engineer ran the pressurization system in manual mode to maximum differential, verified the safety valve worked, and signed off the write-up as "Nil defects." Unfortunately, he forgot to reset the system from manual to auto and the next day the flight crew failed to catch his oversight.

Passing 12,000 ft., the cockpit crew mistook the cabin altitude warning horn to be a faulty takeoff configuration warning (it was the same horn, repurposed). Within a few hours, everyone on board the airplane had passed out. The airplane continued to fly on autopilot at 34,000 ft., flying the ground track of the arrival, instrument approach, missed approach and missed approach holding. Almost 3 hr. after taking off from Larnaca, Cyprus, the aircraft ran out of fuel and crashed into terrain just northwest of Athens International Airport, Greece, killing all 121 passengers and crew.

Going back in time from the crash, the crew made a number of mistakes. They failed to recognize the airplane had not pressurized. They failed to confirm that the pressurization system was in its automatic mode. The ground engineer failed to return that switch from manual to auto, and had applied the wrong procedure to check for a pressurization leak. But, starting it all, the previous crew made an improper maintenance squawk. As it turns out the aft service door seal was leaking. The ground engineer's use of maximum cabin differential masked the leak by giving it more air than it would receive during normal flight conditions. It is speculation on my part, but I think had the ground engineer read the original squawk, his corrective action may have been different.

I think the pilots before the mishap flight could have done a better job investigating the "hard bangs" and should have shown more interest in an aircraft seal freezing in flight. But that might be unfair of me. Many of us in business aviation have a distinct advantage over our peers in the airline world because we tend to fly a smaller number of aircraft. We learn by rote what is normal and what deserves greater attention. Having a flight crewmember record meaningful information with enough detail to give the technician a good sense of what happened and when, will improve the odds of a successful corrective action.

I admire the talent of a good test pilot who can fly the airplane while making note of what the airplane is doing with enough detail to record everything important. But even the best test pilot these days will have the help of a countless number of sensors and computers to record it all. In some cases they will employ chase aircraft. What do we in the operational world have?

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A camcorder on a tripod secured to a divan to capture airplane video

Years ago, some of our pilots started complaining about adverse yaw during landing gear extension and retraction in our Gulfstream G450. Our original squawks must have seemed like the "airplane flies funny" write-up. "Feels like a little yaw for a few seconds when we extend the landing gear" hardly gives the mechanic much with which to start. After a few weeks of this, we began to notice a time difference of a few seconds between the green lights on one main gear versus the other. Noting "Right gear retracted 2 sec. after left gear" improved the troubleshooting. Our mechanics inspected the system thoroughly and still came up empty. Our airplane has a full set of cameras on the tail and belly, but no way to record the results.

I secured a portable video recorder onto a tripod and that tripod onto our forward divan with the cushions removed. I secured that setup with divan seat belts and a set of C-clamps. After one flight around the visual pattern we had a recorded history of the delay of our right landing gear to retract and extend; the delay was clearly with the right inboard gear door. Armed with this information, technicians were able to trace the problem to a worn bearing in the right landing gear door. The problem would have gotten worse and we could have been put into a situation where the gear would not retract, or worse yet, would not extend.

Be Skeptical: Think Like a Mechanic

There is a story in a NASA Aviation Safety Reporting System (ASRS) newsletter about a British airline test pilot who was charged with testing the autoland equipment that his airline was installing on its fleet. He carried out a test on an airplane and squawked: "Autoland carried out. The aircraft landed very firmly and well to the left of centerline. Most unsatisfactory." In response, the engineer in charge wrote: "Autoland not fitted (installed) to this aircraft."

It is well and good to have a laugh at this test pilot's expense, but the lesson here is we should look at every squawk with a skeptic's eye. What is the mechanic going to do with this? You should examine every write-up and look for a simple solution before sending the maintenance team on a wild goose chase.

Years ago, a Boeing B-52 crew returned from a flight squawking the fuel-low light as coming on too early. The crew chief quickly determined the bomber had landed with less than 10 min. of fuel remaining, certainly qualifying as low fuel in just about anyone's book.

Even with a valid squawk, pilots should realize that what seems obvious at altitude and noted in pilot speak may be nothing more than gibberish hours later on the ground in mechanic lingo.

Be Precise: Write Like an Engineer

As a Purdue engineering student, one of my most prized possessions was a T-shirt that said, "I Are An Engineer." Yes, we took pride in our inarticulate illiteracy because that somehow meant we were technically pure. We were taught to place a priority on "data in" and the engineering work, at the expense of the "data out." Engineering degree in hand, I quickly figured out the world is not run by engineers and that if the customer didn't understand the output, the input and engineering effort were pointless. But even with this backdrop, my pilot actions often overpower my engineering intentions.

Years ago, my aircraft had a series of standby altimeter problems. Passing about 20,000 ft. it stopped working. A few hours later, it was OK. How does a pilot squawk this? "Standby altimeter intermittent." You can predict the corrective action: "No fault found. Returned to service."

My fellow pilots were no better, and the airplane racked up an impressive six flights with the same problem. This was years before the GoPro had been invented, but I did have my trusty pencil and notebook, so on the next flight I recorded everything. (If you have already figured this out, you are smarter than me.)

The standby altimeter stopped working not as a function of altitude, but of temperature. When the Outside Air Temperature (OAT) dipped below 0C or so, the altimeter — wait for it — froze. Now our mechanics had something to go on. They took the static lines apart and out came about a half cup of water. A drain hole had clogged with debris, causing the water to act as a pressure conduit when warm but blocking all sensed pressure when frozen. Once the water was drained and the blocked hole cleaned, everything worked as it should again.

Be Purposeful

I once returned from a month's vacation and picked up a maintenance logbook where a discrepancy sign-off promised a story more interesting than the squawk it corrected. I had to investigate.

A few weeks prior, one of our pilots squawked the HF after returning from an overseas trip: "HF inop." The signoff was predictable: "Ops check good." A few days later following a domestic trip that didn't require the HF, the same pilot wrote: "HF still inop," which was followed by "Ops check good" but I think could have been improved by "Ops check still good." This was followed by another domestic trip with this post-flight note: "I told you guys the HF is broken. Can't you do anything right?" Our mechanics showed great restraint with a simple, "Ops check good" again.

The next week, another pilot returned from an overseas trip with a more detailed squawk: "HF1 transmit unreadable when keyed from pilot's control head, works OK from copilot's side. Receiver unaffected. HF2 works without issue." The discrepancy sign-off was again sterile, but correct: "Pilot's intercom panel HF switch open circuit, removed/replaced intercom panel, HF 1 ops check good." And to the right of that in the margin was a comment in the original pilot's handwriting, "Finally!"

All of that may sound petty but it was an accurate predictor of the frosty relations that followed. The "I told you" pilot never hesitated to bad mouth the maintenance team, which never hesitated to vent their frustration behind his back. A sloppy squawk was followed by implicit accusations of incompetence. We pilots need to remember the mechanics are on our side but simply removing and replacing parts without cause is expensive and time-consuming. We should expect the best of intentions on both sides of the squawk sheet and that will pay dividends in the future.

Years later, I returned from a trip and felt a tremor in the brakes that I had never felt in many years. In older aircraft the anti-skid would chatter at your feet. A newer system may kick at you when you are applying maximum pressure but should otherwise be quiet. I squawked the brakes, mindful of the qualitative nature of my write-up: "Applied brakes at 100 kt. using moderate pressure and felt vibration from right brake pedal, a forceful pushback in the pedal two times a second until we were at taxi speed. Copilot did not sense this and aircraft's braking performance unimpacted."

Our mechanics spent hours looking for a problem to no avail and one of them called me at home. I described the problem in more detail and thanked him for the call. The next morning, I found a plastic bag filled with metal parts that looked like they had been through a bartender's blender. The mechanic on duty explained that they removed the hubs from both wheels and verified everything looked OK. So, they replaced the hubs, taxied the airplane at low speed and verified the brakes worked. They told the director of maintenance that all ops checked good. But he told them to look again since, "This pilot doesn't write things up for no reason. There has to be something wrong." The mechanics repeated this step, this time removing the anti-skid speed sensors from the hubs. One of those sensors fell apart in their hands and found a new home in the see-through bag on my desk.

You can spend your career flying like a test pilot, thinking like a mechanic and writing like an engineer; but none of that will do you any good if you don't have the respect and trust of your maintenance team. Never use a squawk sheet to vent your frustration; rather write your squawk as if you were the reader. You and the mechanic are in this together and both want the same thing: a repaired aircraft. Today's write-up will impact future sign-offs. **BCA**

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Mechanic John Chambers "chases" a hydraulic system write-up on a Gulfstream G450.