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In 2015, 76 fuel-management accidents involving general aviation airplanes comprised 46 flight-planning-related accidents, 20 related to systems operation, and 10 related to contamination, according to the twenty-seventh *Joseph T. Nall Report*.

OWNERSHIP |

Eliminating hope

Going to the limit—with confidence

BY THOMAS B. HAINES

DANIEL HERTZBERG

HOPE DOESN'T POWER OUR AIRPLANES, as much as we sometimes might wish it did. Too often we take off and hope we have enough fuel. Or, we take off with what we believe is enough fuel, but along the way, a reroute or headwinds extend our flight time and we begin looking at the fuel gauges, hoping they are accurate. Or, perhaps, hoping that they are as inaccurate as they usually are and that we really have more fuel onboard than the gauges indicate.

Hope destroyed 76 airframes in 2015, according to the AOPA Air Safety Institute's twenty-seventh *Joseph T. Nall Report*, the last year for which complete data were available. Seven of those fuel-related accidents were fatal. That year was no anomaly. For years, we've been losing about 1.5 airframes a week because of fuel exhaustion or mismanagement. And lest you think it's a rookie mistake, 55 percent of the 2014 fuel-related accident flights were commanded by commercial or airline transport pilots. And 41 percent involved retractable-gear and multiengine models, so it's not just a problem with "simple" airplanes.

The truth is, with the average age of the fleet now past 45 years, the fuel gauges in our legacy airplanes are old and often inaccurate. Many of them were not accurate when new. In general aviation, we've come to accept inaccurate fuel gauges as the norm. And with good reason, because for decades there was no choice. But new, accurate choices are emerging, many of them created by CiES Inc., a Bend, Oregon, company that provides fuel-sensing systems to many new aircraft manufacturers and has supplemental type certificates (STC) to install them on dozens of models of older airplanes.

My 1972 Beechcraft Bonanza A36 was typical. The fuel gauge needles looked more like windshield wipers than any reasonable assessment of the go-juice on board. I had long ago dismissed them, relying on before-takeoff visual checks in the tanks and the JP Instruments EDM 800 digital indication, which uses a transducer to measure the fuel that flows to the engine. And it does that well, usually indicating within a half gallon of what is actually in the tanks. But, the EDM-800 only knows how much fuel I told it was in the tanks. It doesn't actually measure the fuel onboard. A fuel leak, for example, would never be detected.

When passengers began to point at the lethargic needles and then wonder about the airworthiness of the rest of the airplane, I decided to do something about it and contacted CiES. I'd read about their STCs and knew they had one for the A36.

CiES founder and President Scott Philiben is an engineer, a pilot, and the son of an A&P mechanic. His involvement in a project to measure the fuel loads in crush-resistant helicopter fuel tanks—an area where his patented magnetic field fuel-sensing technology worked well—got him started. He then tackled a challenge from Cirrus to improve the fuel sensing in its airplanes. He later developed STCs for installation of his fuel sensors in everything from Britten-Normans to SIAI Marchettis and most anything in between. Since then, he has delivered some 18,000 units, including those at work in 5,000 airplanes. And, to date, he is not aware of any fuel-exhaustion accidents in those airplanes. CiES donated fuel-sending units to the AOPA Sweepstakes Super Cub.

With their floats on an arm attached to a fuel sensor, his modern devices look similar to those mechanical systems found in airplanes for decades, a feature that gave the FAA a certain comfort when it came time for certification. Plus, they readily fit into the same fuel tank openings as the classic systems. The difference, however, is that the CiES system uses a digital sensor sealed in a box just inside the tank to measure the position of two magnets at the top of the arm. With this system, no electrical current comes near the fuel. "It's like a compass, always pointing to the float," Philiben explains. The movement of the magnets is measured in volts, which can be relayed to a gauge. The Bonanza and many low-wing airplanes require two sensors per tank because of wing dihedral; Barons require three per tank. Cessnas and many other high-wing airplanes require only one per tank because of the lesser dihedral.

Although the mechanical gauges in my Bonanza were of a decent quality when new 46 years ago, the FAA won't allow CiES to display fuel information on mechanical

gauges. Instead, I removed both gauges and installed a single Aerospace Logic digital gauge, which represents fuel levels in the left and right tank by vertical bars with a digital readout of the number of gallons remaining in each tank at the bottom of each bar—down to a tenth of a gallon.

Those who already have a digital gauge of some sort, such as a JPI EDM 900 engine management system, can connect directly to the CiES sensor.

Friend and A&P/IA Adrian Eichhorn did the installation on my airplane, taking about two days to complete the job, including the rather tedious effort of calibrating the Aerospace Logic gauge—which requires draining the tanks and adding in two gallons of fuel at a time and recording certain readings as you go. Philiben's rule of thumb is that it takes about four to five hours per sensor for the installation, including running the necessary wires and calibrating the gauge. So Eichhorn's two-day experience is about typical.

I've now been flying for nine months with the system and am impressed by its accuracy. When I record the amount the gauge says is remaining and compare that with what the fuel truck pumps in, they are always within 0.5 to 2.5 gallons of each other. For example, after a recent long trip, the gauges reported I had 22.6 gallons on board. At 74 gallons usable, I should need 51.4 gallons to top it off. The truck pumped 49 gallons in, a difference of 2.4 gallons, one of the larger spreads. My return trip from EAA AirVenture left me with 25.4 gallons in the tanks, suggesting a need for 48.6 gallons. The truck added 49.4 gallons, a difference of 0.8 gallons.

The bottom line is that I no longer have to hope I have enough fuel on board. I can now comfortably fly longer distances, getting more utilization out of the airplane—and perhaps making fewer fuel stops—because I have confidence in the amount of fuel really on board.

CiES charges $435 for digital sensors and $495 for those requiring an analog output. The Aerospace Logic gauge, should your installation require it, is $879. **AOPA**

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