MANAGING SYSTEM FAILURES

We're all taught the basics of partial panel flying. But what would you do if more than one instrument or system decided to fail simultaneously?

by Fred Simonds

Imagine you're IFR in IMC, halfway to your destination, atop the world at 8,000 feet, on course with the autopilot navigating via the GPS, everything humming along as it should. Sweet.

In the next few minutes you reset the heading indicator, or DG, twice. Hmmm, that's unusual. Then you begin to sense something more is amiss. You can't put your finger on it, but that little chime in your head just won't go away.

A minute or two later you notice the attitude indicator shows a slight turn to the right. That's odd. The autopilot is navigating the GPS track which is arrow-straight. There should be no turning. The turn coordinator shows no turn and the DG has wandered again.

You have just lost your triangle of agreement. The three roll instruments—the attitude indicator, DG and turn coordinator—should have the same opinion. Likewise, pitch instruments including the attitude indicator, altimeter and vertical speed indicator should form their own triangle. Power instruments should also agree: for instance, the airspeed should be appropriate for a given manifold pressure and/or tachometer setting.

The roll disagreement turns that chime in your head to a warning siren. Could this be a vacuum failure in progress?

Sure enough, the vacuum gauge confirms low pressure, heading toward zero. Now you know why that little chime was going off. Vacuum failures are subtle, but you caught it before losing control. Now what?

The Air Force teaches that the first thing to do in an emergency is wind your watch, an oblique way of saying, "First, do nothing." Why? Because it's better to do the right thing slowly than the wrong thing quickly. Ben Franklin's famous phrase, "haste makes waste" and Hippocrates' "first, do no harm," echo the same timeless truth.

Aviate, Navigate, Communicate

Are you aviating? Yes, the airplane is under control. Navigating? Yes again, you are on course. The autopilot is flying the GPS course and staying level with the electric turn coordinator.

Next, cover those failed instruments with paper or anything at hand. Studies show that your odds of survival increase markedly if you do.

Last, inform ATC. Loss of instruments under IFR calls for a malfunction report under FAR 91.187. Your call to ATC must include:

- Your aircraft number;
- The equipment affected;
- The degree to which your ability to operate IFR in the ATC system is impaired;
- The nature and extent of assistance you desire from ATC.

Continuing IFR like this is pointless. Partial panel is a stopgap contingency best used to find one's way to VMC. The safest move is to declare an emergency, ask ATC for a vector to a VMC airport and land while the situation is still under control.

Need To Know

As this scenario illustrates, it is essential that you know which gyro instruments are vacuum and/or electrically powered. Second, know your autopilot. What instruments does it depend on? If it is a position-based or synonymously an attitude-based autopilot, then it likely depends on the attitude indicator as its gyroscopic reference. If the attitude indicator is vacuum-driven, a vacuum failure will take the autopilot down with it.

Alternatively, if the autopilot is rate-based, it draws gyroscopic input from the turn coordinator, which is usually electric. This form of redundancy is typical in many light aircraft. Either way, you must know how the autopilot works.

Manage All Your Resources

Let's presume that you are fortunate to have a panel-mounted GPS and an autopilot. With GPS you can fly headings in NAV mode or by hand. Given a failed DG, attempting to fly the autopilot in heading mode with the bug will probably not work.

If you lack GPS, you still have VOR, the compass and ATC as sources of heading information. Lacking an autopilot means flying with just the turn coordinator and airspeed indicator. This can be extremely hard work, especially in bumpy weather. In my personal experience as an instrument instructor, I've found that even experienced pilots lose their concentration after 30 minutes or so at best. Partial panel in IMC is an emergency that requires the pilot to get to visual conditions, or to an airport, as quickly and as safely as possible.

Without the attitude indicator you have no direct reference to the horizon and so can find yourself in an unusual

attitude very quickly. Once again, the autopilot can save the day by making standard rate turns, holding altitude, and making stable climbs and descents with just a few button pushes.

Some handheld GPS units offer an electronic AI or even HSI as well as a pseudo-DG. While not legal IFR legal, using one of these is better than losing control of the airplane, getting lost or becoming disoriented. You can make it legal if you declare an emergency because under FAR 91.3 you can do whatever is necessary to the extent needed to meet the emergency. If you don't declare one, ATC can and likely will declare one for you.

Murphy's Not Done Yet

As it turns out, you must continue IFR since there is no VMC within your fuel range. At some point, you notice that the altimeter needles have frozen, and the airspeed is suddenly way off. Unbeknownst to you, dirt has clogged the static port.

If you are fortunate, you have an alternate static port valve you can open, but remember that everything reads worse when it's on: altitude reads higher than you are and airspeed reads a few knots faster than actual.

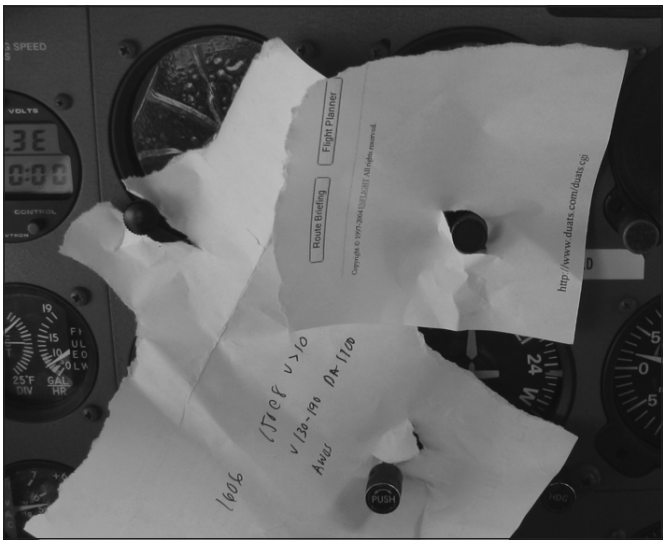
By the way, don't confuse the alternate induction system with the alternate static system. Pulling the induction system valve is guaranteed not to restore static pressure.

Without an alternate static port, the rather dramatic solution is to break the glass on the VSI and so get static pressure into the system through the cockpit. Doing so will likely break the needle. You will lose the VSI but regain airspeed and altitude information—a better-than-fair trade.

Remember that the VSI works through a calibrated leak. Rapid altitude and airspeed changes will take a few seconds to appear on the dials.

Once again, your avionics can help in unlikely ways. You may have a transponder that shows you the pressure altitude being reported to ATC, which can double as a crude altimeter. Similarly, some GPS units can show pseudo-altitude which is also not very accurate but better than nothing.

If your autopilot has altitude capability, it may have its own static source as many late-model Cessnas do. You can use the autopilot for altitude control, but make sure the altimeter setting in it is current.



All right, you activated the alternate static air, but soon the airspeed needle flutters and drops to zero even though the altimeter shows level flight and engine instruments are normal. You should have turned the pitot heat on before entering IMC and probably from takeoff, but if it wasn't on, you turn it on now. It does not help: insects made a nest in the tube because it was never covered on the ground. Air pressure has forced the nest in deeper and now the tube is hopelessly blocked.

There is no contingency for a failed airspeed indicator, though you might approximate your airspeed by referencing GPS or DME ground speed if you know the wind direction and speed. With a fixed-pitch propeller the tachometer may indicate lower in a climb and higher in a descent. Loss of this indicator is very serious because there is now no reliable way to sense an impending stall or excessive airspeed, which could precipitate structural failure.

In Extremis

To paraphrase Ernest K. Gann, author of *Fate Is the Hunter*, when one thing fails it often produces a cascade of further failures, and today is no exception. Without warning, the electrical system rolls over and dies. You cycle the master switch off for 30 seconds and then back on again. Nothing. All the circuit breakers are in. You cycle the avionics master switch without success. There are no more electrons to be had.

Your sole remaining option is to head toward VMC using the compass for heading and flying at VFR altitudes. If there is no hope of reaching VMC, at least fly toward an area free of obstructions such as towers or mountains. Aim for an unpopulated area where a forced landing is unlikely to harm anyone on the ground.

If you do encounter VMC, get out your sectional and navigate by pilotage. Call me old school, but you should always carry sectional charts for any IFR trip you make, regardless of the navigation equipment you have onboard. These cheap paper charts could save your life when all else fails.

Above all, never give up. Pilots in the most desperate of circumstances survived to fly another day because they were just too stubborn to give up. Your odds of surviving a low-speed forced landing under control are good. We owe it to our families, friends and passengers to do our best no matter what. That's what being a pilot is truly about.

Fred Simonds is an active Gold Seal CFII with more than 1,500 hours of instrument instruction given. He lives in North Palm Beach, Florida.