

**Airborne Unlimited – Most Recent Daily Episodes**

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Wed, Dec 11, 2002

## Joint ASF/FAA Study On Vacuum Pump Failures

### Proper Training Makes Pilots Better Able to Cope with Vacuum Pump Failures in IFR Conditions



A new study by the AOPA Air Safety Foundation and FAA's Civil Aerospace Medical Institute (CAMI) shows that pilots are better able to cope with a vacuum pump failure in actual aircraft than previous simulator-based studies had reported.

"We expected that pilots receive more sensory inputs during an actual flight than in a simulator," said ASF Executive Director Bruce Landsberg. "In fact, that appears to be the case. Our study pilots fared somewhat better in the actual aircraft than the pilots in earlier studies using only visual simulators, particularly in complex aircraft."

A vacuum pump failure disables the attitude and heading indicator in most general aviation aircraft, leading to the possibility of spatial disorientation for pilots flying in instrument conditions. About three accidents a year are attributed to spatial disorientation due to a vacuum pump or instrument failure.

Despite that relatively low number of accidents, some previous studies using only visual simulators suggested that the majority of pilots in aircraft with retractable landing gear weren't prepared to deal with the emergency and fly with the remaining instruments, known as "partial panel" flying.

But the ASF/CAMI study using real aircraft showed that the loss of the attitude indicator or other gyroscopic instruments need not be a killer if a pilot receives adequate training and keeps current on the ability to recognize a vacuum system failure and fly with reference to a partial panel.



In the study conducted during 2001 in actual aircraft, all 41 test subjects were instrument-rated pilots. Their ages and levels of experience covered a wide spectrum. The test subjects flew one of two aircraft modified to simulate failure of the attitude and heading instruments without the pilots' knowledge. Each was told that he or she would be part of a study to evaluate pilot performance under simulated instrument meteorological conditions (IMC).

The pilots were divided into two groups: one flying a Piper Archer (PA-28) and one flying a Beechcraft Bonanza (A36). The Archer pilots were subdivided into three groups, each of which suffered the loss of attitude indicator and heading indicator.

- Group 1: No annunciator warning light, no training provided prior to the flight
- Group 2: 30 minutes simulator training provided prior to flight, no annunciator warning light
- Group 3: Vacuum failure warning annunciator light, no training provided prior to flight

The Bonanza pilots were divided into two groups:

- Group 1: Attitude indicator failure
- Group 2: Attitude indicator failure and horizontal situation indicator (HSI) failure



On average, the Archer pilots took longer to recognize the failure than did the Bonanza pilots (6.7 minutes vs. 3.6 minutes), but all Archer pilots successfully concluded the flight. Significantly, the Archer pilots who received the simulator training spotted the problem more quickly than the others (4.9 minutes vs. 6.7 minutes), although the annunciator light did not appear to give the pilots in the third group any advantage over the pilots in the first two groups. It should be noted that the annunciator was not easily visible in the daylight.

While the Bonanza pilots recognized the problem more quickly than the Archer pilots, four of the 16 were deemed to have lost control and "crashed." All of the "crashes" occurred in the second Bonanza group, which lost both attitude indicator and HSI.

"The results of the second Bonanza group indicate the crucial role backup systems play," said Landsberg. "Having a mix of power sources for vacuum-driven instruments can greatly increase a pilot's ability to deal with the failure of some flight instruments."

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Both in previous simulator studies and the ASF/CAMI study using aircraft, there appeared to be a correlation between the complexity of the aircraft and the ability to safely conclude a flight after instrument failure. An independent CAMI study in 2001 simulated unannounced vacuum failure in two visual simulators, a Cessna 172 and a Piper Malibu, and found a much higher loss-of-control rate in the more complex Malibu (83 percent) than in the 172 (8 percent). In a similar ASF study in 2000 by C.R. Martinez using Cessna 208 and Cessna 210 simulators, two thirds of the 24 test subjects lost control and half "crashed."

Other factors, such as age, currency, and experience, appear not to have played a role in determining which pilots would successfully conclude their flights and which would not.

"The studies point out the need to know emergency procedures if something does go wrong," said Landsberg. "In addition, the Air Safety Foundation recommends that pilots of complex aircraft lower their landing gear if they suspect a vacuum failure, to help maintain stability and to lower airspeed. However, there is no substitute for training, practice, and redundant systems, where possible."

FMI: [www.cami.jccbi.gov/aam-400A/Abstracts/Tech\\_Rep.htm](http://www.cami.jccbi.gov/aam-400A/Abstracts/Tech_Rep.htm)

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