Accident, Incident, Reliability Data and Service History
Avidyne Entegra System

NTSB Case No. NYC07FA083

Accident

Review of the report of a fatal accident that occurred on January 15, 2005 (NTSB case no. IAD05FA032), revealed that avionics failure was a cited as a factor when a pilot took off in an Avidyne Entegra equipped airplane in instrument IMC, and, shortly thereafter, misinterpreted a series of air traffic control instructions to be for his airplane when they were for another airplane. The airplane subsequently descended nose-down, out of clouds, and impacted a house and terrain. The airplane had approximately 98 hours of operation since being manufactured, and had a history of PFD failures. The Safety Board determined that the probable cause of the accident was, in part, "the pilot's failure to maintain aircraft control, which resulted in an uncontrolled descent to the ground. Factors included an avionics failure, pilot disorientation, and instrument meteorological conditions." The nature and cause of the avionics failure could not be determined.

Incidents

According to reports from Avidyne, in 2005, the pilot of a Cirrus SR22 (N4312CB) experienced two PFD failures that resulted in the PFD attitude display rolling inverted while the airplane was in straight and level flight with the autopilot engaged. According to the pilot, the first occurrence was during IFR training with a flight instructor on board in VFR conditions, when the attitude display started a slow smooth roll during the flight. After the attitude display horizon had passed about 45 degrees from horizontal, the "crosscheck attitude" box appeared on the PFD. Additionally, the MFD indicated a turn, and no instruments were "X'ed out" or gave any indication of failure. The PFD continued to respond to flight control inputs as if it was working properly. During the return flight, the indicated horizon continued the slow roll through inverted and upright again and back through inverted. A new PFD with a flight director was installed and the pilot continued his IFR training. About 15 flying hours later in visual meteorological conditions (VMC), the new PFD also performed in a similar fashion, only this time rolling in the opposite direction. The roll was very slow and smooth and it took about 10 minutes before the PFD showed the plane was inverted. The pilot took several photos of the PFD in this condition with his cell phone camera and sent them to Avidyne.

According to Avidyne, these failures stemmed from cracked capacitors. Microscopic exam of parts were conducted and these inspections included both suspected failed parts and random parts pulled from production and service stock as a means of characterizing the scope and cause of the problem. During these exams, capacitor defects were attributed to component

manufacturing problems and post-assembly handling of the printed circuit cards. According to Avidyne, the class of capacitors in question was not manufactured in an "aviation grade". The capacitors originally used were designed for general application with no specific restrictions. As a result, Avidyne released Avidyne Service Alert SA 05-001, which affected approximately 2,000 PFDs. As part of the redesign, components were selected that were designed to be more resistant to flexing and were advertised by the manufacturer as "automotive grade".

Piper reported an incident to the NTSB that occurred on February 1, 2008, when a PA-46R-350T Matrix was being flown by Piper's senior test pilot for sales operations on a pre-delivery test flight in VMC. The flight was the initial flight after a faulty PFD had been replaced due to displaying "Red Xs" on the display in flight. A new PFD was installed and a magnetic calibration was performed before flight. After takeoff and while passing through 900 feet the pilot observed a 7-degree nose-down pitch attitude indication on the PFD while the aircraft was maintaining about an 8-degree pitch-up attitude in climb. The PFD also displayed a "CROSSCHECK ATTITUDE" warning. As the airplane climbed to 3,000 feet, the roll attitude presentation slowly began to indicate that the airplane was rolling to the left. When the PFD reached a 120-degree left roll attitude presentation, the pilot darkened the display screen and returned using the standby instruments. On final approach the pilot turned up the display and found that the PFD was indicating a complete 180-degree inverted attitude. According to the Avidyne, this resulted from a flaw in the magnetic calibration procedure.

On February 22, 2008, a Cirrus SR-22, while in cruise flight at 7,000 feet msl, had four red Xs appear on the PFD while the airplane was flying in IMC and moderate rain. Burning electrical fumes were also detected. The pilot diverted and made an uneventful landing. According to Avidyne, this resulted from a failure of a tantalum capacitor.

On April 24, 2007, NTSB investigators met with Avidyne's Director of Certification, their Customer Service Manager, and their Senior Software Engineer at Avidyne's facility in Lincoln, Massachusetts. During the meeting, NTSB investigators were advised that Avidyne was aware of four erroneous roll attitude indication events (two with Cirrus, one with a Lancair, and one that had occurred on a test bench) due to capacitor cracking. Investigators were also advised that though they had occurred in roll that they could occur in any axis, and that they were aware of instances of screen flickering, intermittent connection, screen blanking, red Xs, small and large scale drifting, rolling, interrupted roll, and instances of roll rates in excess of 360 degrees per minute.

Reliability Data

The NTSB obtained data from four aircraft manufacturers' information regarding Avidyne Entegra system anomalies. The information received covered the period from April 2003 to January 2008. One aircraft manufacturer supplied data for two quarters of the 2005 calendar year and complete data was provided by the three other aircraft manufacturers. Approximately 1,800 entries were provided for the time period. Review of the information revealed, that in many cases the system would exhibit anomalous operation immediately after installation. Multiple types of in-service, anomalies were recorded from a low of 6 hours of operation to a high of 1026.4 hours of operation. These anomalies included but were not limited to, alignment failures, air data

errors, display errors, problems with software, in-flight failure of the units, horizontal lines being displayed, magnetometers not communicating, pitch errors, command bar errors, ADHRS failures, blanking out, flickering, erratic displays, miscompare messages, X-outs, sound and or smoke, and erratic knob operation.

Review of the FAA's Service Difficulty Reporting (SDR) system also revealed anomalies which included but were not limited to reports of smoke, pixilation, smearing, airspeed errors, altitude errors, X-outs, and intermittent operation. Time in operation ranged from a low of 15 hours of operation to a high of 1,009 hours of operation.

On April 25, 2008, the NTSB requested information from Avidyne regarding PFDs that had been either removed from aircraft for field servicing, or returned to Avidyne for service. The NTSB also requested that they provide the unit part numbers and serial numbers, as well as the reasons for removal, repair, or replacement, as well as what discrepancies and /or failures were discovered, and what Avidyne's corrective actions were. In a response letter, Avidyne declined to provide the data requested, citing that the request was overly broad, not relevant, and onerous. Further communications between Avidyne and the NTSB led to a 2-day meeting in Florida to further explore avenues to obtain reliability data.

Service Alerts, Service Bulletins and Airworthiness Directives

Review of corrective actions related to Avidyne systems revealed the following:

-- Avidyne Service Alert (SA) SA-05-001, issued October 17, 2005. Referred to reports of the PFD displaying incorrect attitude and heading information. The incorrect heading information would also be reflected in incorrect changes on the moving map display and cautioned that the autopilot would follow the incorrect presentations if the "heading" mode was selected.

-- Avidyne SA-06-003, issued June 23, 2006. Reported instances of incorrect attitude and heading information on the PFD and advised that the "CROSSCHECK ATTITUDE" warning message could be delayed by up to 45 seconds after the incorrect information was displayed. Cautioned pilots to use the back-up flight instruments in their instrument scan.

-- FAA issued a SAIB CE-07-08 on October 31, 2006, to advise Cirrus, Columbia (now Cessna), and Piper owners of an available modification from Avidyne to "eliminate the possibility" of the PFD presenting misleading attitude and heading information.

--Avidyne Mandatory Service Bulletin 601-00006-067, issued on January 15, 2007. Referenced earlier SAs and FAA SAIB CE-07-08 and required that the PFDs be returned to the factory for an update which would "reduce the likelihood" that the PFD could present erroneous indications. [Note: This SB was not complied with during the most recent annual inspection of the accident aircraft.]

-- Avidyne SA-08-001, issued on February 12, 2008. Advised of reports from the field of PFDs displaying incorrect "altitude and airspeed" information. Stated the following safety warning: "FULL OR PARTIAL FAILURE OF THE PFD CAN LEAD TO SPATIAL

DISORIENTATION OF THE PILOT AND SUBSEQUENT LOSS OF AIRCRAFT CONTROL". According to Avidyne, it was issued due to a solder flux contamination issue in approximately 487 PFDs that were known to have been sent to the Avidyne service center in Florida, for air-data system upgrades and other maintenance between July 27, 2007 and February 1, 2008. However, according to the FAA, Avidyne had traced the airspeed and altitude errors to a manufacturing defect with an air data unit assembly, but could not determine the root cause.

-- FAA then issued AD 2008-06-28 (later revised as AD 2008-06-28R1), on April 10, 2008. The AD required the pilot to be made aware of the reported erroneous indications and to include a back-up instrument scan and to make specific back-up comparisons with the PFD at different phases of flight. The rule required that the PFD and the back-up attitude, back-up altimeter, and back-up airspeed indicators be functional and readily visible to the pilot before flight in instrument conditions. The AD note referenced SA-08-001 which listed 477 serial numbered PFDs installed in several different aircraft types. The preamble to the AD note advised that Avidyne was working to "rework and/or modify" the PFD units and that the FAA would supersede or terminate the limitations when Avidyne completed the rework if approved. On April 30, 2008, Avidyne requested that the FAA issue an Alternate Means of Compliance (AMOC) for AD 2008-06-28R1. According to the FAA, upon review of an Avidyne produced report, they determined that the PFDs with the cited serial numbers which were serviced per at Avidyne's facility, no longer were subject to the root cause defects that resulted in the unsafe conditions cited in the AD.

Follow on Meeting with Avidyne Regarding Quality Control and Servicing

On January 21, 2009, NTSB staff met again with Avidyne at their Florida facility. NTSB staff was advised that Avidyne had no separate quality assurance (QA) and quality control (QC) departments, and both functions were handled by the Director of Quality. There also were no QA and QC groups for software, and they did not have a safety officer. Avidyne also advised that one individual was in charge of both the Part 145 repair station and production and that he supervised approximately 35 to 45 assembly personnel and 15 repair personnel. At the time of the meeting they estimated that they had produced approximately 5,500 units and were receiving an average of 40 to 45 PFDs per week for rework.

The Avidyne representatives indicated that they were not confident that the capacitor cracking SB would be complied with by everyone, and that they would be pursuing an AD, as 450 to 558 units were still in service that were subject to capacitor cracking. They advised that cracks in the capacitors were common and that they could cause a change in the attitude indication, and that they could not rule out that a capacitor problem could have manifested itself on the accident flight. At the time of this report, no AD has been issued to capture the units that were still in service and were subject to capacitor cracking.