National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 27, 2004

In reply refer to: A-04-03

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On March 18, 2002, an Embraer 145 (EMB-145), N643AE, operating as American Eagle flight 3602, experienced a loss of attitude and heading indications on the first officer's (No. 2) primary flight display (PFD) after takeoff from Will Rogers World Airport (OKC), Oklahoma City, Oklahoma. A similar failure occurred on the captain's (No.1) PFD seconds later. The crew declared an emergency and prepared to return to OKC. While returning to the airport, the captain's display indications returned to normal. The airplane ultimately landed without further incident. Instrument meteorological conditions (IMC) prevailed for the 14 *Code of Federal Regulations* Part 121 passenger flight.

According to the pilots, the attitude and heading information disappeared from the No. 2 PFD as the airplane climbed through approximately 4,000 feet. In place of the attitude and heading information, the No. 2 PFD displayed "ATT FAIL" and "HDG FAIL" indications, and failure messages appeared on the engine indicating and crew alerting system display. The pilots indicated that, seconds later, a similar failure occurred on the No. 1 PFD. The flight crew stated that airspeed indications remained normal and that the first officer continued to fly using the standby instruments while the captain attempted to determine the source of the problem.

The pilots reported that, after the attitude and heading information returned to the No. 1 PFD, they verified that this information agreed with the standby instruments, then the captain assumed control of the flight. The first officer reported that the No. 2 PFD continued to display failure flags and that he selected the attitude and heading reference system (AHRS)[1] button to send the attitude and heading information being provided to the No. 1 PFD to the No. 2 display. The first officer indicated that, during the return flight, he toggled between his original display and the information being provided to the No.1 PFD and confirmed that the failure indications remained on the No. 2 PFD. According to the pilots, the final approach and landing were

[1] The EMB-145 is equipped with two identical and independent AHRSs. The primary component of each is the AH-800 computer. Each AH-800 provides attitude and heading data to a corresponding integrated computer (IC-600), which processes and transmits the data for display on its corresponding PFD.

uneventful. The first officer stated that, as they taxied to the gate, the failure indications on the No. 2 PFD disappeared and the attitude and heading information returned to normal without any further action by the crew.

Analysis of digital flight data recorder (DFDR) data confirmed a failure of the No. 2 PFD.[2] Postincident inspection of the airplane revealed no faults in the wiring and connectors between the AH-800 computers and IC-600s or with the busses providing electrical power to the AH-800s. Both AH-800s and IC-600s were sent to the manufacturer for further examination. Examinations of the IC-600s and the No. 1 AH-800 revealed no contamination or faults related to the incident flight. However, some of the motherboard connectors on the No. 2 AH-800 exhibited evidence of contamination and corrosion. Analysis of the corrosion residue indicated that water was the likely source of the contamination. According to Embraer, 18 of 160 AH-800s removed for routine examination on EMB-135, -140, and -145 airplanes revealed water-related contamination. Embraer believes that contamination of the AH-800s, which are located in the forward avionics bay beneath exhaust fans, is a result of condensation forming in the area of the exhaust fans and dripping down onto the units.

The Safety Board is aware that Embraer has developed a shield for installation below the exhaust fans that is designed to protect the AHRS computers and other components from moisture that accumulates in the area of the exhaust fans. Testing conducted by Embraer showed that the shield is effective in protecting the components from water ingress. On June 16, 2003, Embraer issued Service Bulletin (SB) 145-21-0036, which called for the installation of the protective shields on a limited number of one operator's EMB-145 airplanes for evaluation purposes. However, the installation of the shields on these airplanes has been delayed. Embraer has since indicated its intention to broaden the applicability of the SB to include all EMB-135, -140, and -145 airplanes since the AHRS computer installation and exposure to water contamination are similar for the other models. The Safety Board is encouraged by the potential of a protective shield to address the contamination problem and believes that all EMB-135, -140, and -145 airplanes should be modified to prevent fluid contamination of AHRS computers.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require that Embraer 135, 140, and 145 airplanes be modified to prevent fluid contamination of the attitude heading reference system computers. (A-04-03)

Chairman CONNERS, Vice Chairman ROSENKER, and Members CARMODY, GOGLIA, and HEALING concurred with this recommendation.

Original Signed

By: Ellen Engleman Conners
Chairman

[2] DFDR data revealed no failure of the No. 1 PFD; there was no indication that the No. 1 PFD displayed AHRS information from the No. 2 AH-800 at any time during the flight.