



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** February 27, 2003

**In reply refer to:** A-03-02 and -03

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

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On March 19, 2001, about 1825 eastern standard time, N266CA, an Empresa Brasileira de Aeronautica, S/A (Embraer) EMB-120, operated by Comair Airlines, Inc., as flight 5054, encountered icing conditions while in cruise flight at 17,000 feet mean sea level and departed controlled flight, descending to an altitude of about 10,000 feet.<sup>1</sup> The pilots recovered control of the airplane and diverted to West Palm Beach, Florida, where they landed without further incident. Flight 5054 was operating under 14 *Code of Federal Regulations* Part 121 as a scheduled international passenger flight from Nassau International Airport, Bahamas, to Orlando International Airport, Florida. The 2 flight crewmembers, 1 flight attendant, and 25 passengers were uninjured, and the airplane sustained substantial damage to the elevators and horizontal stabilizer. During the National Transportation Safety Board's investigation of this accident, investigators learned that both of the electronic attitude display indicators (EADI)<sup>2</sup> failed during the upset, resulting in the loss of primary attitude information to the flight crew. Although unrelated to the cause of the accident, the Safety Board believes this issue warrants the Federal Aviation Administration's (FAA) attention.

### Background

Flight data recorder data from flight 5054 indicate that about 1825 (when the airplane began to depart controlled flight), torque indications for both engines were about 55 percent, airplane pitch attitude was at approximately 7° airplane nose-up, and the autopilot disengaged. The airplane's pitch attitude decreased as the airplane rolled about 80° to the left, then back to near level. During the next 20 seconds, engine torque increased to about 98 percent on both engines, the airplane rolled about 110° to the left, returned to level flight, rolled about 130° to the

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<sup>1</sup> The description of this accident, DCA01MA031, can be found on the National Transportation Safety Board's Web site at <<http://www.ntsb.gov>>.

<sup>2</sup> EADIs are multicolor cathode ray tube units that display the airplane's attitude. The attitude display consists of a blue and brown screen, representing the sky and ground, respectively; a white horizon line with roll and pitch scales; a yellow airplane symbol; and a roll pointer.

right, returned to level flight, then rolled 360° to the right before returning to near wings level, with torque on both engines stabilized at about 22 percent. The maximum nose-down pitch attitude was 60°; the maximum recorded airspeed was about 240 knots indicated airspeed, and the maximum vertical acceleration during recovery was about +3.6 G.

Postaccident interviews with the flight crew indicated that, during the upset, both of the EADIs “blacked out,” resulting in the loss of all primary attitude information to the crew. The captain reported that, although the display screens occasionally flickered, they continued to show red flags,<sup>3</sup> indicating the displays were unavailable.<sup>4</sup> The pilots stated that, because the attitude displays were flickering, they believed the displays would return quickly, so they did not transition to the backup attitude indicator that was available to them. The flight crew recovered the airplane using visual cues once the airplane broke out of the clouds. After the flight crew recovered the airplane, the EADI displays returned, and the flags disappeared.

## Discussion

Both AHCs on flight 5054 were model AHC-85 and were manufactured by Rockwell Collins.<sup>5</sup> The manufacturer’s operation specifications for the AHC-85 require that the unit produce valid data for pitch, roll, and yaw rates up to 128° per second of pitch, roll, and yaw. The Safety Board’s investigation determined that roll rates varied during the upset but did not exceed the operation specifications until about 30 seconds after the upset began. Because both EADIs on flight 5054 blacked out well before the roll rate exceeded 128° per second, the AHCs were sent to Rockwell Collins for benchtesting in accordance with Rockwell Collins’ production test and final alignment requirements (PTR).<sup>6</sup> According to these requirements, the units are to be tested under yaw rates greater than 18° per second but less than 100° per second and pitch and roll rates of 10° per second. During the PTR testing, the first officer’s AHC was found to have an intermittent rate failure; however, no discrepancies were found with the captain’s AHC.

Because the accident airplane rolled severely during the upset, both units were then tested under roll rate conditions greater than those required by the PTRs but less than the operating specifications. When this test was attempted with the first officer’s AHC, it did not initialize properly due to an excessive pitch error. The unit generated erratic pitch and yaw rate readings even when sitting still on the bench. The captain’s AHC, which had passed the PTR testing, generated an invalid data flag when exposed to a roll rate of 40° per second in the clockwise direction, and 40° to 50° per second in the counterclockwise direction.

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<sup>3</sup> Neither crewmember recalled what the flags said when they appeared on the EADI screens.

<sup>4</sup> Each EADI display is generated by information from an attitude heading computer (AHC) (there is an AHC for each pilot’s EADI). When the AHC fails, a red invalid data flag with the letters “ATT” inscribed appears above the yellow airplane symbol on the EADI. The pitch scale, roll pointer, sky/ground raster, and command bar displays are removed, and the system takes approximately 40 seconds to reset before any additional information is displayed.

<sup>5</sup> Rockwell Collins is the common name for the Rockwell International Corporation, Collins Avionics Group.

<sup>6</sup> PTRs are used in manufacturing and repair to test an assembled component and verify its operation. According to the Rockwell Collins PTR for the AHC-85, “These tests are intended to assure that equipment performance will equal or exceed published specifications and will satisfy customer expectations and operational requirements.”

As a result of the testing conducted at Rockwell Collins on the AHCs from the accident airplane, the Safety Board's investigation determined that the current PTRs for the AHC-85 model do not confirm that the unit will operate throughout its specified operating range. In addition, no testing at rates higher than the PTRs is required after production or at any other maintenance level. When questioned by Board investigators about the testing requirements, a Rockwell Collins representative replied that high-rate testing was not required because the unit's performance could be inferred from the results obtained during low-rate testing. The Rockwell Collins representative provided no explanation for the performance of the captain's AHC, which passed the PTR testing but failed when exposed to roll rates higher than those required by the PTRs. When asked how long the captain's AHC may have been operating in a degraded condition, the Rockwell Collins representative replied that it was a "benign latent condition" and that it was impossible to determine how long it had existed.

The Safety Board notes that although the flight crew of Comair flight 5054 was able to recover the airplane, the loss of primary attitude indications can inhibit the recovery of an airplane, especially during an upset when the attitude indications are most critical. The Board is concerned that Rockwell Collins' testing requirements for AHC-85 model units are inadequate and create a possible safety hazard by allowing faulty units with benign latent failures to enter service. Although these units likely provide acceptable performance during normal operations, they may not be capable of producing primary attitude indications within conditions consistent with operating specifications, specifically during an upset condition. Therefore, the Safety Board believes that the FAA should instruct Rockwell Collins to modify its PTRs for the AHC-85 model to demonstrate that each AHC-85 unit is capable of operation throughout its specified operating range of 128° per second of roll, and ensure that the modified test procedures are incorporated in production and postproduction maintenance requirements.

Additionally, the Safety Board is concerned that both units on the accident airplane failed nearly simultaneously due to maneuvering, which indicates that the hazard may not be isolated. Therefore, the Board believes that the FAA should require that all AHC-85 model units be tested in accordance with the modified test requirements recommended in A-03-02 to ensure that each unit is capable of operation throughout its specified operating range.

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

Instruct Rockwell Collins to modify its production test and final alignment requirements for the AHC-85 to demonstrate that each AHC-85 is capable of operation throughout its specified operating range of 128° per second of roll, and ensure that the modified test procedures are incorporated in production and postproduction maintenance requirements. (A-03-02)

Require that all AHC-85 model units be tested in accordance with the modified test requirements recommended in A-03-02 to ensure that each unit is capable of operation throughout its specified operating range. (A-03-03)

Acting Chairman HAMMERSCHMIDT and Members GOGLIA, BLACK, and CARMODY concurred in these recommendations.

*original signed*

By: John A. Hammerschmidt  
Acting Chairman