



**National Transportation Safety Board**  
Washington, D.C. 20594

**Safety Recommendation**

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Date: January 9, 1998

In reply refer to: A-97-123 through 125

Honorable Jane F. Garvey  
Administrator  
Federal Aviation Administration  
Washington, D.C. 20591

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Since June 1996, the National Transportation Safety Board has investigated three incidents in which segments of the elevator trim cabling system have failed on Short Brothers SD3-60 airplanes.<sup>1</sup> In each case, the cable fractured during flight, and the airplane landed safely without injuries to the passengers or crew and without being damaged. On two of the airplanes, the cable segments that control the nose-up trim failed at identical locations adjacent to pulleys. The cable on the third airplane also separated near a pulley location but was in a nose-down trim cable segment. Metallurgical examinations conducted by the Safety Board established that all three separations were the result of fatigue cracking of the individual wire strands in the cable.

Short Brothers does not specify a life limit on the elevator trim cables and designates them for "on-condition" maintenance. Maintenance documents specify that the cables be visually inspected every 4 years or 4,800 hours, without regard to service cycles. At present, the visual inspections are performed with the cable installed in the aircraft and under normal tension loads. The elevator trim cables on all three incident airplanes had been inspected within 2 years of the failures and had an average service time of 2,128 hours since inspection. Following a similar in-flight trim cable failure in July 1994, Executive Airlines, dba American Eagle, reduced the time between visual inspections for its SD3-60 airplanes to 2,400 hours. The cable that failed on the American Eagle airplane on July 9, 1996, had last been inspected in February 1995 and had accumulated 2,247.5 hours since the inspection.

Given the service hours on the incident airplanes, the present 4,800-hour inspection interval appears to be excessive. Further, unaided visual inspections on installed cables are not adequate to detect incipient failures. An improved inspection procedure would require relaxing the cable tension to allow close magnified inspections, particularly at pulley locations; however, even with improved inspection procedures, fatigue cracking in individual wire strands may not be

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<sup>1</sup> (a) MIA 96-I-A146, June 2, 1996, N826BE, operated by Gulfstream International Airlines, Inc.; (b) MIA 96-I-A179, July 9, 1996, N384MQ, operated by Executive Airlines, dba American Eagle; and (c) MIA97-I-A160, May 9, 1997, N263GA, operated by Gulfstream International Airlines, Inc.

detectable by visual inspections alone. Because of this, the Safety Board believes that a life limit should be established on these cables based on their failure history.

The Safety Board's review of service difficulty reports (SDRs) from 1974 to April 1997 for Short Brothers SD3-60 aircraft revealed 27 additional failures of cable segments in the elevator trim system. Of the 27 total failures, 24 were reported to have occurred during flight. Two of the nose-up trim cable segments<sup>2</sup> were prominent in the SDR list, each experiencing nine failures. The SDR database does not list time since last inspection for any components. Further review of the SDRs revealed that the total time on the failed cables was listed for only 6 of the 24 failures that occurred during flight. The total service time for these six airplanes combined with that for the three incident airplanes averaged 13,602 hours.

Short Brothers (USA), Inc., reports that there have been 13 instances of unscheduled removals of trim cables on aircraft operated outside of the United States. The information reported for foreign operators did not indicate the reason for removal but did indicate a "mean time between unscheduled removals" that averaged 52,301 service hours. The reason is not known for this substantially greater time in service.

Nearly 44 Short Brothers SD3-60 airplanes are currently in service in the United States; all of them use cable-operated manual elevator trim systems. Many foreign operators use electric trim systems. The manual trim systems operate through a series of interconnected cable segments, pulleys, chains, and two jackscrews at the elevators. Failure of any cable segment locks the elevator trim at the existing setting and prevents any further trim adjustment. Depending on the trim setting at the time of cable failure and on phase of flight, the control column forces necessary to counteract the trim setting could be greatly increased.

The inability to properly trim the aircraft could lead to an unsafe condition, particularly during critical phases of flight or in combination with other factors such as an engine failure. Although failures of segments of the elevator trim control cables have not resulted in accidents or injuries, the potential for such an accident exists; action is needed to minimize the potential. The Safety Board believes that the Federal Aviation Administration (FAA) should establish life limits on the elevator trim control cable segments in Short Brothers SD3-60 airplanes based on the failure history of the segments, and then require operators of SD3-60s to incorporate the life limits in their airplane maintenance programs. The Board further believes that the FAA should substantially reduce the inspection interval for the elevator trim cables and require an inspection technique, particularly at pulley locations, that is more detailed than a visual inspection alone.

During its investigations of the three incidents that occurred since June 1996, the Safety Board found that significant useful information—including part numbers, total aircraft, and component times—was incomplete or missing from the SDR database. In addition, the SDR database does not track component service cycles or the time since last inspection. Reporting component failures for inclusion in the SDR database is mandatory for Part 121 and Part 135 operators and is voluntary for general aviation. Currently, operators forward these data to the

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<sup>2</sup> Part numbers SD3-45-6028XA and -6030XA.

FAA through a service difficulty report (SDR) form,<sup>3</sup> a malfunction or defect report (M or D) form,<sup>4</sup> or for about 60 operators, by electronic means. Neither the M or D form nor the SDR form includes sections for reporting the service cycles of individual components or the time since last inspection or overhaul. The Safety Board extensively uses the SDR database in support of its accident investigations, safety studies, and safety recommendations. The usefulness of the data, however, is often diminished by the lack of accurate and complete information.

The Safety Board is aware that the FAA is presently restructuring the service difficulty reporting system. The Board urges the FAA to modify the system so that it contains more complete and accurate information about component failures; for example, (a) revise the service difficulty report forms and database to include cycles and times since last inspection or overhaul for failed components; (b) relate to the operators who submit SDRs the need for complete and accurate information when they report component failures; and (c) remind FAA inspectors assigned to Part 121 and 135 operators of their need to review the component failure reports for accuracy and completeness.

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

Establish life limits on the elevator trim control cable segments in Short Brothers SD3-60 airplanes based on the failure history of the segments, then require operators of SD3-60s to incorporate the life limits in their airplane maintenance programs. (A-97-123)

Substantially reduce the inspection interval for the elevator trim cables in Short Brothers SD3-60 airplanes and require an inspection technique, particularly at pulley locations, that is more detailed than a visual inspection alone. (A-97-124)

Modify the service difficulty reporting system so that it contains more complete and accurate information about component failures; for example, (a) revise the various Service Difficulty Report (SDR) forms and database to include cycles and times since last inspection for failed components; (b) relate to the operators who submit SDRs the need for complete and accurate information when they report component failures; and (c) remind Federal Aviation Administration inspectors assigned to Part 121 and Part 135 operators of their need to review the component failure reports for accuracy and completeness. (A-97-125)

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<sup>3</sup> FAA form 8070-1 (11-84).

<sup>4</sup> FAA form 8010-4 (10-92).

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall". The signature is written in a cursive style with a large initial "J" and "H".

By. Jim Hall  
Chairman