



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: February 28, 1992
In reply refer to: A-92-6 and -7

Honorable Barry L. Harris
Acting Administrator
Federal Aviation Administration
Washington, D. C. 20591

On September 11, 1991, an Embraer Brasilia EMB-120 airplane, operated under 14 Code of Federal Regulations (CFR) Part 135 as Continental Express Flight 2574, crashed near Eagle Lake, Texas. The flightcrew had begun to descend from about 24,000 feet 11 minutes before the crash. Inbound to Houston's Intercontinental Airport, passing through 11,800 feet, the leading edge of the left horizontal stabilizer separated from the airplane. Performance evaluations have thus far determined that loss of the leading edge's aerodynamic surface, combined with the sudden increase in drag caused by the exposed flat structural plane on the left side of the horizontal stabilizer, led to an almost immediate stall of the horizontal stabilizer and rapid pitch down of the airplane's nose. The negative loading on the airplane's structure resulted in the left wing folding under the fuselage and the subsequent breakup of the airplane. Witnesses said that the airplane was consumed by a fireball and that only the wing tips were outside the fireball. It then entered a flat spin until ground impact. All 14 persons aboard were fatally injured.

The investigation revealed that the airplane had undergone maintenance work in the Continental Express hangar at Houston Intercontinental Airport the night before the accident. During the second shift, the scheduled removal and replacement of both the left and right horizontal stabilizer leading edge/deicer boot assemblies were undertaken. The removal of each leading edge requires the removal of more than 40 screws from both the top and bottom of each assembly. Two mechanics and an inspector assisting in the work gained access to the "T-Tail" by use of a work platform. They removed the screws from both the top and the bottom of the right side leading edge. The inspector walked across the top of the "T-Tail" and removed the screws from the top of the left side leading edge. However, a maintenance personnel shift change occurred before the work was completed, and the bottom screws were never removed from the left side leading edge assembly and, more importantly, the upper screws were not replaced.

The right leading edge assembly was removed by the second shift and replaced by the third shift, and upper and lower screws were reinstalled. The work involving both leading edges was not indicated in the maintenance shift turnover log, and the incoming third shift supervisor was not verbally informed of the partial removal of the left side leading edge hardware. The

third shift supervisor decided to postpone replacement of the left side horizontal stabilizer leading edge because of the limited time available to complete such work; therefore, the airplane was pushed out of the hangar at 11 p.m. to make room for work on another airplane, and was subsequently signed back into service. During the morning preflight check, there is no evidence that the flightcrew had any knowledge of the work done on the airplane prior to departure. Moreover, the top of the horizontal stabilizer cannot be seen in a normal preflight walk-around inspection.

The airplane was assigned a morning passenger flight to Laredo, Texas. The accident took place on the return trip from Laredo to Houston.

A detailed investigation was completed on the maintenance procedures and personnel activity at the Houston base of Continental Express. The investigation revealed no issues related to the fitness for duty of any maintenance personnel. Tests on urine and blood samples provided by 14 mechanics, inspectors, and supervisors who worked on the accident airplane proved negative for drugs and alcohol. In addition, there was no evidence to suggest that personnel fatigue was a factor in the accident. The investigation revealed no direct deficiencies in the airline's General Maintenance Manual (GMM), the FAA-approved procedures under which all company maintenance is performed. The GMM contained clear procedures which, if followed, could have prevented the accident. However, the investigation revealed deficiencies by maintenance personnel in complying with the company procedures outlined in the GMM, and deficiencies in general supervision and management practices in the maintenance department. Several deficiencies of importance in the accident sequence are as follows:

- 1) The GMM specifies that it is imperative for maintenance/inspection forms to be completed to ensure that no work item is overlooked (GMM 1, Section 3, Paragraph 10). Also, the GMM specifically addresses several methods to ensure proper turnover during shift changes (GMM 1, Section 5, Paragraph 7). However, it was found that on the night before the accident, when both the left and right upper screws and the right lower screws were removed from the boot assemblies during the second shift, no entries were made on the appropriate work cards. The work cards were not issued to the mechanics but remained in a maintenance watch list package in the supervisor's office. The second shift supervisor said that he had directed the commencement of work for a short period as a way of assisting the third shift mechanics and that the work cards remained with the work package. He said that the procedure of not completing paperwork was common practice and was intended to expedite the third shift maintenance schedule. The mechanics, inspector, and other supervisors involved in the change from second to third shifts did not question this practice.

- 2) The GMM specifies procedures to be followed for shift changes that include briefings by mechanics to supervisors, as well as briefings by outgoing supervisors to incoming shift supervisors. On the night before the accident, the supervisor who assigned the

work did not request an end-of-shift briefing from the mechanics performing the work, and he did not perform a shift turnover briefing to the third shift supervisor. Another second-shift supervisor, who normally supervised the mechanics, was provided a shift turnover briefing by the mechanics, but the supervisor failed to provide an adequate shift turnover briefing to the incoming third-shift supervisor who was responsible for the accident airplane. Confusion existed among the second-shift supervisors regarding these responsibilities. As a result, the information about the screws that were removed from the left upper side of the horizontal stabilizer was not relayed.

According to the GMM-1, Section 1, 1-6, "personnel performing maintenance will follow and be familiar with the instructions as outlined herein....Instructions and information, contained herein, bring Continental Express into compliance with the appropriate Federal Aviation Regulations. For this reason, it is essential that the contents be followed." The investigation revealed that some practices in the airline's hanger were not being performed in accordance with the GMM and that these practices reflected accepted procedures.

The Safety Board is aware that Continental Express management has implemented some remedial actions since this accident intended to correct the cited deficiencies in the maintenance department. The Safety Board is also aware that the FAA conducted a National Aviation Safety Inspection Program (NASIP) team inspection of Continental Express shortly after the accident. According to a letter of November 18, 1991 to the airline management signed by then FAA Administrator James B. Busey, "During our inspection, the team favorably noted that Britt Airways [doing business as Continental Express] has implemented an internal evaluation program. The inspection revealed very few safety deficiencies, a fact we attribute, in part, to the success of your internal evaluation system." The Safety Board believes it is possible that Continental Express took action following the accident to assure that the procedures required in the GMM were followed on the hangar floor thus correcting deficiencies that existed prior to the accident.

Nonetheless, the Safety Board is concerned that the limited scope of the NASIP inspection may have failed to observe areas relevant to the accident. Significantly, the NASIP inspection did not report observations of shift turnover procedures. Therefore, the Safety Board believes that the FAA should further enhance NASIP procedures to augment the detection of situations where shop practices may deviate from approved procedures.

Interviews were completed with the former and current FAA principal maintenance inspectors (PMIs) for Continental Express responsible for overseeing the company's maintenance work. The former PMI oversaw Continental Express for 28 months, until June 1991. He indicated that the merger of two large commuter airlines and assets of a third (Britt Airways, Rocky Mountain Airways and Bar Harbor Airlines, respectively) occurred during this period to form the current Continental Express Airlines. In his view, these events considerably limited his time for on-site inspections. He

stated that he could keep up with the number of inspections required, but that the depth and quality of these inspections were limited by the lack of time. The PMI indicated that he operated for about 1 year as the sole inspector at the airline's Houston headquarters, and that during this time he had additional certificates for which he was responsible. In addition, he was also responsible for overseeing the merger of the two 14 CFR 135 operators into Continental Express. The PMI indicated that the situation had improved because of the addition of one assistant and the removal of other certificate responsibilities. However, he indicated that in view of the size of the carrier, additional assistance would be needed to adequately complete the required workload. The Safety Board is concerned that maintenance practices that had developed in the Continental Express hangar did not conform with the GMM and were not detected by FAA surveillance. The Safety Board believes that the PMI's excessive workload contributed to the lack of adequate surveillance.

As a result of its investigation of an accident involving a De Havilland Twin Otter operating as Aloha IslandAir Flight 1712 at Halawa Point, Molokai, Hawaii, on October 28, 1989, the Safety Board determined that the local FAA office may have had insufficient experienced personnel to accomplish its mission of surveillance of the airline. The Safety Board made the following recommendation to the Federal Aviation Administration:

A-90-136

Perform a special study of the adequacy of Flight Standards District Office staffing considering the availability of work hours, the geographic area of responsibility, and the size and complexity of the assigned operations.

On February 8, 1991, the FAA responded to Safety Recommendation A-90-136, indicating that it had contracted for a study to be completed by October 1991, that would revalidate its staffing standards and would include the availability of work hours, geographic areas of responsibility, and the size and complexity of operations. Additionally, the contract provided for a 1-year validation period in which the contractor was to monitor the implementation of the standard. The Safety Board classified A-90-136 as "Open-Acceptable Response," pending receipt of further information.

The Safety Board has received no further correspondence from the FAA on the status of this effort. However, informal staff inquiries have disclosed that the contractor study is now scheduled for completion in February 1992.

More recently, following its investigation of the midair collision involving a Lycoming Air Services Piper Aerostar PA-60 and a Sun Oil Company Bell 412 helicopter at Merion, Pennsylvania, on April 4, 1991, the Safety Board determined that, because of his workload, the principal operations inspector for Lycoming Air Service did not have sufficient time to adequately survey the operator. The Safety Board reiterated Safety Recommendation A-90-136.

Based on evidence obtained in the investigation of the Continental Express accident, the Safety Board believes that a review of the FAA's ability to conduct adequate oversight of Continental Express is warranted. Therefore, the Safety Board again reiterates Safety Recommendation A-90-136.

Additionally, the Safety Board is concerned that common maintenance shop floor practices at Continental Express deviated from the company's General Maintenance Manual, and that these deviations were not detected by FAA surveillance prior to the accident and were apparently not evident immediately following the accident. The Safety Board believes that current FAA Flight Standards surveillance and NASIP inspection procedures may not be adequate to detect deviations of air carriers' actual practices from their written procedures.

The Safety Board previously expressed concern about the effectiveness of NASIP inspections and flight standards surveillance of air carrier maintenance. Following the April 28, 1988 accident near Maui, Hawaii of an Aloha Airlines Boeing 737, the Safety Board's investigation identified deficiencies in the airworthiness of the air carrier's fleet and deficiencies in FAA surveillance. As a result of its investigation, the Safety Board recommended that the FAA:

A-89-62: Revise the National Aviation Safety Inspection Program objectives to require that inspectors evaluate not only the paperwork trail, but also the actual condition of the fleet airplanes undergoing maintenance and on the operational ramp.

A-89-63: Require National Aviation Inspection Program teams to indicate related systemic deficiencies within an operator's maintenance activity when less than satisfactory fleet condition is identified.

In a letter to the Safety Board dated May 24, 1991, FAA Administrator James B. Busey indicated that the FAA had made revisions to its NASIP program and routine surveillance to emphasize hands-on inspections and to stress the importance of quality inspections versus an inappropriate emphasis on quantity. He also stated that the FAA emphasizes the importance of identifying, documenting and correcting systemic deficiencies.

The Safety Board is encouraged by these developments, and believes that the FAA has made important improvements in its inspection programs. However, the current accident again raises the need for further enhancements of the inspection programs. The Aloha Airlines accident demonstrated a need for attention to the physical fleet, while the current accident demonstrates a need for attention to actual maintenance shop practices. The Safety Board believes that the FAA should continue to emphasize hands-on inspection. Also, to improve inspectors' abilities to detect deviations of air carriers' actual practices from their written procedures, the FAA should conduct unannounced spot inspections of air carrier fleet condition and shop procedures during the hours when maintenance is in progress. Finally, to identify systemic problems of fleet condition and shop procedures, the FAA

should develop a system to identify trends in maintenance inspection findings, and it should enhance surveillance on the effectiveness of air carriers' quality assurance and internal safety audit programs.


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

Enhance flight standards surveillance of Continental Express, to include sufficient direct observation of actual maintenance shop practices to ensure that such practices conform to the Continental Express General Maintenance Manual and applicable Federal Aviation Regulations (Class II, Priority Action) (A-92-6).

Enhance flight standards Program Guidelines, including the National Aviation Safety Inspection Program, to emphasize hands-on inspection of equipment and procedures, unannounced spot inspections, and the observation of quality assurance and internal audit functions, in order to evaluate the effectiveness of air carrier maintenance programs related to aircraft condition, the adherence to approved and prescribed procedures, and the ability of air carriers to identify and correct problems from within. (Class II, Priority Action) (A-92-7)

The essential elements of Safety Recommendations A-89-62 and -63 are included within Safety Recommendation A-92-7. Consequently, Safety Recommendations A-89-62 and -63 are classified "Closed--Acceptable Response/Superseded."

Acting Chairman COUGHLIN and Members LAUBER, HART, HAMMERSCHMIDT and KOLSTAD concurred in these recommendations.


By: Susan M. Coughlin
Acting Chairman