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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: January 8, 1985

Forwarded to:

Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-85-01 through -04

On December 6, 1984, a Provincetown-Boston Airlines, Inc., (PBA) EMBRAER Bandeirante (EMB-110), N96PB, operating as Flight 1039, crashed shortly after takeoff from the Jacksonville International Airport, Jacksonville, Florida. All 13 persons on board were killed, and the airplane was destroyed.

The National Transportation Safety Board's continuing investigation has disclosed that the airplane's elevators and horizontal stabilizer separated in flight, rendering the airplane uncontrollable. Evidence to date indicates that the horizontal stabilizer separated from the fuselage at bulkhead 33 along the top righthand corner of the stabilizer attachment fitting. This area of the bulkhead is supported by C-shaped, P/N 4A-1411-08, and U-shaped, P/N 4A-1411-07-17, channels which are riveted together. The function of these channels appears to be to transfer the aft and downward loads on the forward attachment points of the stabilizer to the monocoque structure through longerons and the outer fuselage skin.

Metallurgical examination of the separation at the bulkhead has disclosed evidence of pre-accident working and/or sheared rivets in the upper two "C" channels. There was extensive fretting between mating surfaces of the upper righthand "C" channel and the "U" channel, around the three upper outboard attachment rivets. The bulkhead web adjacent to the right upper outboard corner of the "U" channel contained a fatigue crack measuring about 5/16 inch, which emanated from the aft surface of the web and propagated forward through the thickness of the web. There are indications of a heavy buildup of deposits on the fractures in the web, suggesting that intermittent tearing of the web could have occurred both inboard and down around the stabilizer's forward attachment fitting. The fatigue cracking and possible tearing most likely resulted from reduced stiffness where the "C" and "U" channels were joined; the reduced stiffness in turn resulted from the loose or sheared rivets which had developed before the accident.

On December 28 and 29, 1984, a Safety Board metallurgist inspected three PBA EMB-110 airplanes at PBA's maintenance facilities in Tallahassee and Tampa, Florida. The airplanes inspected were N57DA, N65DA, and N108CA which were being modified in the area of bulkhead 33 as stipulated in Airworthiness Directive (AD) 83-14-09, Amendment 39-4527, paragraphs (d) and (e), and EMBRAER Service Bulletin (SB) 110-53-019, figures 4 and 5. This modification required installation of an additional U-shaped reinforcing channel, P/N 110-1411-07-30-01 or -04, around new "C" channels, P/N 110-1410-07-30-07 or -09. The connection of the "C" channel and reinforcing channel sections to the existing U-shaped machined channel is made with Hi-lok fasteners which are of larger diameter and higher shear strength than the rivets originally used in the assembly. The "C" and the reinforcement channels, however, are attached to the longeron and fuselage skin by means of "bucked" rivets similar to those used in the original assembly. The SB also calls for more rivets at the aft position where the modification attaches to the fuselage skin. Installing many of the rivets to the skin not only is difficult because of workspace limitations but also can produce damage to both the skin and the web of bulkhead 33. In fact, based on the metallurgist's examination, recent installation of this reinforcing kit on N57DA apparently had caused a crack in the web of bulkhead 33. The outer fuselage skin was dimpled inboard as a result of the higher concentration of rivets, and there was an approximately 3/4-inch crack in the web just inboard of where the web angles forward under the rivets. According to the SB, bulkhead cracks in this area were to be repaired by means of a contoured repair sheet, P/N 110-1411-07-30-03 or -06, and a smaller reinforcement sheet, PN 110-1411-07-30-02 or -05, also provided as a kit from EMBRAER per SB 110-53-019. If cracks are found, a substantial portion of the bulkhead is to be cut away and a contoured repair sheet is to be installed. The bulkhead repair is reinforced only by a smaller reinforcement sheet near the top of the contoured repair sheet. As a result of this repair procedure, there is a 3-inch-long gap where the repair sheet is butted to the web forward of and adjacent to the stabilizer attachment fitting. This type of repair would appear to be less effective because of the gap than a repair requiring placement of an additional sheet on the forward side of the bulkhead web and underneath the machined "U" channel without any cutout of the bulkhead web. While the Safety Board has been concerned about the repair and modification procedures; the result of the modification in stiffening the area on the outboard upper corners of bulkhead 33 and frame 32, when implemented as intended, appears to be superior to the original assembly.

The Board also has been concerned that inspections of unmodified airplanes conducted in accordance with the FAA's emergency AD issued December 9, 1984, may not reveal loose or sheared rivets. PBA maintenance personnel have indicated that the area of concern is difficult to inspect and that the visual inspection called for in the emergency AD, of itself, is not adequate to determine whether rivets are loose or sheared. This was confirmed by the Safety Board's metallurgist. Additionally, PBA maintenance personnel found during modification of the airplanes with the reinforcement kit that the joint in question had sheared and loose rivets, even though the rivets appeared to have been intact during visual inspection. The operator's reports submitted to the FAA in response to the emergency AD are not conclusive regarding the detection of loose or sheared rivets in the joints of the "C" channels and machined "U" channels, because the reports of loose rivets in bulkhead 33 have not been specific about the location of the loose rivets. Based on this information, the Safety Board believes that other unmodified airplanes may be in service with loose and/or sheared rivets in major structural members of the horizontal stabilizer attachment.

In summary, (1) the horizontal stabilizer attachment structure on the EMB-110P1 and -110P2 model airplane, as originally designed and installed, is susceptible to damage which can adversely affect its load-carrying capability, (2) the modification specified in AD 83-14-09 and SB 110-53-019 to correct structural deficiencies can cause undetected damage in the area of bulkhead 33, and (3) the inspection procedure specified in the emergency AD is not adequate to detect damage.

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

Issue an airworthiness directive (AD) to require, that before further commercial operation in the United States, the horizontal stabilizer attachment of EMB-110P1 and -110P2 model airplanes not previously modified in accordance with AD 83-14-09, Amendment 39-4527, paragraph (d) or (e), be inspected using an improved inspection procedure to enhance detection of loose or sheared rivets, particularly where bulkhead 33 transmits the loads from the stabilizer forward attachment to the fuselage monocoque structure. The inspection procedure should require removal of controls as needed for access to riveted joints and application of external loads to detect relative movement between structural members. The AD should require that deficiencies detected during inspection be reported to the FAA and that they be corrected in accordance with an approved procedure before further flight. (Class I, Urgent Action) (A-85-01)

Revise airworthiness directive (AD) 83-14-09 to require within a specified period that the horizontal stabilizer attachment structure of EMB-110P1 and -110P2 model airplanes be modified in a manner similar to that described in Amendment 39-4527, paragraph (d) or (e), which requires the repair of any cracks in the web of bulkhead 33 and the replacement of the original "C" channels with redesigned channels and modified rivet patterns. Review the crack repair procedures of the AD for adequacy, and require modification of the procedures to eliminate "bucking" of rivets at locations difficult to access and other procedures likely to damage existing structure. (Class I, Urgent Action) (A-85-02)

Conduct a directed safety investigation of EMB-110P1 and -110P2 model airplanes that have been modified in accordance with the provisions of AD 83-14-09, (Amendment 39-4527, paragraph (d) or (e)), to determine whether any structural damage has been inflicted in the area where the horizontal stabilizer attaches to bulkhead 33 and take the corrective action indicated by the results of the directed safety investigation. (Class I, Urgent Action) (A-85-03)

Notify appropriate foreign civil aviation authorities and/or foreign operators of EMB-110P1 and -110P2 model airplanes of the circumstances of the Provincetown-Boston Airlines accident of

December 6, 1984, and of the actions recommended to U. S. operators. (Class I, Urgent Action) (A-85-04)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in these recommendations.

By: Jim Burnett
Chairman