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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 24, 1990

In reply refer to: A-90-117 and -118

Honorable James S. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 29, 1989, an Eastern Airlines Boeing 727-225, N8835E, landed with the right main landing gear partially extended at the William B. Hartsfield Atlanta International Airport, Atlanta, Georgia. The flightcrew reported a malfunction in the right main landing gear actuation system after takeoff from Albany, New York. The cockpit cautionary indicator lights for the right main landing gear and main gear door did not extinguish at the completion of the post-takeoff gear retraction cycle. Subsequently, efforts to remedy the malfunction, including normal recycling of the landing gear, manual extension attempts, and flight maneuvers, which subjected the landing gear to positive and negative "g" loads, were unsuccessful. The right main landing gear could be neither fully extended nor fully retracted. Therefore, the left main landing gear and nose landing gear were fully extended manually and the right main landing gear was left in the partially extended position in preparation for the landing at Atlanta. The landing resulted in minor damage to the airplane's lower outboard wing panel, right wing leading and trailing edge flaps, outboard aileron, and right main landing gear tires and gear doors. No injuries were sustained by the 46 passengers or 7 crewmembers aboard.

Normal retraction and extension of the main landing gear occurs as follows: Selection of the cockpit gear handle to the up position initially directs hydraulic pressure to the door actuators to open the doors. The doors open downward and inboard. When the doors reach the full open position, the linkage mechanically sequences pressure to the retraction side of the main landing gear actuators. The landing gears then retract into the wheel wells and latch into mechanical up locks, and the gear position mechanically sequences pressure to the door actuators to close the doors. The doors are then driven upward and outboard to fit flush with the fuselage body contour. The landing gear door actuator piston rod includes an internal locking mechanism that locks the doors in place. The proper extension of the actuator also results in contact with a microswitch that extinguishes the door lights in the cockpit after the retraction cycle is completed. The gear extension cycle is essentially the reverse of the retraction cycle except that hydraulic pressure is sequenced to the extension side of the main landing gear actuators.

The National Transportation Safety Board's investigation of the incident involving N8835E disclosed that the right main landing gear had jammed against the inboard landing gear door apparently because of an out-of-sequence condition. As a result, hydraulic pressure could not be applied to the main landing gear actuator, and the mechanical interference between the landing gear and the door mechanism prevented manual extension of the landing gear. The out-of-sequence condition did not reoccur during subsequent ground cycling of the landing gear. However, the Safety Board believes that the condition was caused by a loose landing gear door actuator fitting coupled with normal inflight vibratory loads on the gear door mechanism. The fitting is attached, through a serrated plate (for rigging), to the inboard door with bolts and self-locking nuts which, according to the Boeing 727 Maintenance Manual, should be torqued from 25 to 42 foot-pounds after door rigging is completed. The bolts on N8835E were found undertorqued. One bolt was tightened to 10 foot-pounds, the other two could be turned by hand. All other landing gear and door actuating components functioned properly and were within prescribed tolerances.

An out-of-sequence condition as a result of loose bolts was substantiated during landing gear retraction tests previously conducted by the Safety Board on Boeing 727 airplanes in connection with a similar landing gear malfunction incident. During the tests, when the door with the loose actuator fitting was moved toward the closed position while the gear was retracting, as it might do inflight, the retraction cycle was interrupted and the landing gear started to freefall. The Boeing Company, following an analysis of the effects of loose actuator bolts, also concluded that a loose actuator fitting can prevent retraction of the affected main landing gear. As a result, Boeing Service Letter No. 727-SL-32-47, "Main Landing Gear Door Actuator Fitting Attachment Bolts," was issued on December 2, 1983, concerning this potential problem. The service letter suggested that operators inspect the door actuator fittings to ensure that they are correctly and securely fastened. The Boeing Company, apparently prompted by the most recent landing gear malfunction in Atlanta, issued a notice on December 18, 1989, to all operators of Boeing 727 airplanes emphasizing the need to inspect the fittings in accordance with SL 727-SL-32-47.

The landing gear extension system on N8835E was equipped with a production safety feature consisting of a safety bar attached to the wheel-well door mechanism. The safety bar was designed to prevent the landing gear doors from interfering with the landing gear wheels and tires when they were extended manually. However, the production safety bar was not designed to guard against such interference under missequencing conditions when the landing gear extension system was being operated normally with hydraulic pressure. Therefore, in March 1980, the Boeing Company issued Service Bulletin No. 727-32-275, "Main Landing Gear Door and Safety Bar Mechanism Modification," which provided for the installation of a new, improved safety bar mechanism capable of preventing mechanical interference under hydraulic missequencing conditions. Boeing estimates that only about 20 percent of the Boeing 727 domestic fleet is equipped with the new safety bar.

On February 15, 1983, another Eastern Airlines Boeing 727-225, N8831E, landed with the left main landing gear partially extended at Miami International Airport. The circumstances surrounding this incident are similar to those involving N8835E. The tires of the left main landing gear

jammed in the wheel-well door when the flightcrew attempted to retract the landing gear following takeoff from West Palm Beach Airport. After unsuccessful attempts to remedy the malfunction, the landing at Miami was performed with the right main landing gear and nose landing gear retracted. The landing resulted in damage to the lower fuselage keel beam, the inboard trailing edge flaps, and the landing gear doors. Seven passengers sustained minor injuries during evacuation of the airplane. On October 28, 1983, the captain of a United Airlines Boeing 727 experienced similar jamming of the landing gear following takeoff from O'Hare International Airport in Chicago, Illinois. In this case, the captain was able to free the landing gear using "g" loads and returned to O'Hare for an uneventful landing. A subsequent examination of the airplane disclosed that the landing gear door actuator attachment fitting was loose.

The latter two incidents prompted the Safety Board to issue Safety Recommendations A-83-2 (Class I, Urgent Action) and A-84-65 (Class III, longer term action) to the FAA. The first one recommended issuance of an airworthiness directive requiring immediate and subsequent preflight inspection of Boeing 727 landing gear door actuator attachment fittings for proper torque and security. In lieu of an AD, the FAA issued Maintenance Bulletin (MB) 32-28 to all principal maintenance inspectors of Boeing 727 airplanes requesting them to recommend to their assigned Boeing 727 operators a fleet inspection of the fittings at timely intervals. The second recommendation urged the FAA, in conjunction with Boeing, to determine if installation of the new improved safety bar identified in Boeing Service Bulletin 727-32-275 should be made mandatory in order to preclude main landing gear/wheel-well door jams. The FAA and Boeing concluded that FAA Maintenance Bulletin 32-28 and Boeing Service Letter 727-SL-32-47 adequately addressed the problem of loose fittings and that the improved safety bar should remain an optional installation.

The Boeing Company recently advised the Safety Board of its intention to issue a service bulletin in the near future to modify Boeing 727 landing gear door actuator attachment fittings to ensure that the fittings remain correctly and securely fastened. The Safety Board concurs with this action and believes that such a modification should be made mandatory on all Boeing 727 airplanes without the new, improved safety bars. Moreover, the recent incident at Atlanta involving N8835E demonstrates the need to inspect the currently installed fittings for security at periodic intervals.

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

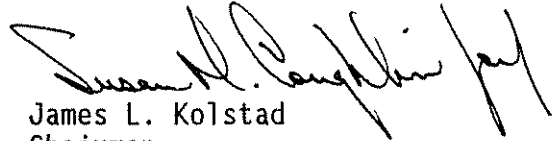
Issue an airworthiness directive applicable to Boeing 727 airplanes without new improved landing gear safety bars, installed during production or per Boeing SB 727-32-275, requiring immediate and recurring inspections of the landing gear door actuator fittings for security and bolt torque in accordance with Boeing Service Letter No. 727-SL-32-47. (Class II, Priority Action) (A-90-117).

Issue an airworthiness directive applicable to Boeing 727 airplanes without new improved landing gear safety bars, installed during production or per Boeing SB 727-32-275,

requiring modification of the landing gear door actuator fittings to ensure that they remain correctly and securely fastened. The Boeing Company anticipates the issuance of a service bulletin in the near future regarding this subject. (Class II, Priority Action) (A-90-118).

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER, BURNETT, and HART, Members, concurred in these recommendations.

By: James L. Kolstad
Chairman

A handwritten signature in cursive script, appearing to read "Susan H. Coughlin". The signature is written in dark ink and is positioned above the typed name of the Chairman.