

Log # 2655



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: SEP - 9 1997

In reply refer to: A-97-97 through -98

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

On August 25, 1996, at 0710 eastern daylight time, a Trans World Airlines (TWA) Lockheed L-1011, N31031, operating as flight 778, scraped the lower aft fuselage while landing at John F. Kennedy International Airport (JFK), Jamaica, New York. The airplane was operating under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121. The landing, which occurred in deteriorating weather conditions, was the scheduled termination of a non-stop cross-country flight that had departed the previous night from Las Vegas, Nevada. The airplane sustained substantial damage to its lower aft fuselage section during the landing. There were no reported injuries to the flightcrew, the cabin crew, or the passengers.

The examination of the airplane after the landing showed that the wing leading edge slats were not in the extended position, although the flaps were extended to the 33° position. Flight data recorder (FDR) information confirmed that the slats did not deploy during the approach or landing.

Safety Board staff evaluated the flightcrew performance during the approach and found that the flightcrew had rushed the approach procedures because of excessive airspeed early in the approach. Additionally, the crew was offered, and agreed to, a change from runway 4R to 4L, resulting in the late configuration of the airplane for landing. During the transition, the autopilot was used, and the autoland system was engaged. The autothrottles would not engage, and the autothrottle fail lights illuminated on the pilot's overhead panel. According to the flightcrew, three attempts at resetting the system were unsuccessful. The first officer used manual throttles during the approach but allowed the autopilot to control the airplane's pitch, roll, yaw, and navigation. The autopilot flared the airplane for the landing; the airplane landed nose high with a high rate of descent and scraped the tail on the runway.

The Lockheed L-1011 slat system consists of 14 individual slats (seven per wing) that are attached to the leading edges of the left and right wings. The slats automatically extend to their fully deployed position when the flap lever is moved to command a flap position of 4° extension (flap lever micro-switch). The slats are retracted when the flap lever is retracted from the 4° position. The slats are extended by a drive system consisting of multiple drive tubes connected

by flexible couplings. The drive system has a hydraulic power drive unit (PDU) located in the left wing root area. The system has two slat system brakes, located in the left and right wingtip areas, that sense shaft speed and motion. To prevent unmanageable slat asymmetry and uncontrollable flight control malfunctions, the slat system brakes activate, locking the drive system, and, thus, the slats in position. To prevent slat asymmetry, both brakes activate together if either rotational sensor senses a different number of turns than the opposite (left or right) sensor. The brakes also activate independently if either brake senses rotational movement greater than about 1,500 rpm. [Normal drive system operational rpm is between 800 and 1,200 rpm.]

Two slat indicator lights are located at the top of the flap position indicator on the front instrument panel. The left light is the LE (leading edge) Transit (yellow) light and the right light is the LE EXT (extended) (green) light. Control logic inhibits simultaneous light illumination. There are 14 green slat indicator lights on the flight engineer's panel along with a two-pointer (left and right) indicator gauge. The 14 green lights are activated by micro-switches through a logic system to indicate individual slat positions. The pointers indicate the approximate positions of the left and right slat systems. Asymmetric warning lights on the flight engineer's panel illuminate when the left and right slat system brakes sense a difference in turns and lock the slats in position.

Safety Board staff examined and tested the airplane's slat system. The examination revealed that the right brake had locked the slats at a 0.3 inch extension. When electrical power was applied to the airplane systems, it was noted that the indicator needles showed a slat position near 0°, corresponding to the locked slat position. The examination further revealed, and the operator's system information confirmed, that with one brake locked, no warning lights or green indicator lights will illuminate, and the slat indicator needles will not move. Tests of the slat system showed that when the right slat brake was reset by maintenance personnel, the slat system extended and retracted normally in response to flap lever position. The flight engineer panel indications were noted to be normal for all slat movements. No other faults were found during the slat system testing or during the slat logic system bench-test at the operator's overhaul facility.

Further examination of the slat extend drive system revealed that the driveshaft couplings were worn and could be overrotated by hand after the slats were partially deployed. According to a manufacturing representative, loose slat drive couplings can cause the right brake to trip when the slats are extended and slight air turbulence is encountered. The airplane's maintenance history showed that more than 12 discrepancies had occurred in the past 2 years in which the slats did not extend as commanded by flap lever movement. The corrective actions varied and included right brake replacement, left and right brake switch replacement, and resetting of the right brake. TWA's and Lockheed's inspection criteria did not specify wear limits or provide guidance for inspection of the slat drive couplings.

Specific written inspection criteria, including the establishment of wear limits, are critical to the proper inspection and maintenance of slat drive systems to prevent undesired slat brake application, slat asymmetry, and hard landings. For this reason, the Safety Board believes that

the FAA should, in conjunction with Lockheed, develop and disseminate to all operators, specific written criteria, including wear limits, for the inspection and maintenance of L-1011 slat drive systems, in particular slat drive coupling wear, to prevent undesired slat brake application, slat asymmetry, and hard landings.

Lockheed Service Bulletin (SB) 093-27-128 describes the installation of an optional flap indicator for the Lockheed L-1011 that incorporates a flashing red warning light in the flap indicator gauge on the front instrument panel that warns of a slat/flap disagreement. Although TWA did not elect to install this indicator in its fleet of L-1011s, some operators of the L-1011 have the warning light installed.¹ This additional warning light provides a greater margin of safety by actively alerting flightcrews of slat malfunctions, rather than requiring flightcrew awareness to detect slat system anomalies. For this reason, the Safety Board believes that the FAA should require operators of the Lockheed L-1011 to replace flap indicators, in accordance with SB 093-27-128, with indicators having flashing red warning lights when the slat system position disagrees with the flap-commanded position in those L-1011 airplanes that are not already in compliance with the SB.

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

In conjunction with Lockheed, develop and disseminate to all operators, specific written criteria, including wear limits, for the inspection and maintenance of L-1011 slat drive systems, in particular slat drive coupling wear, to prevent undesired slat brake application, slat asymmetry, and hard landings. (A-97-97)

Require operators of the Lockheed L-1011 to replace flap indicators, in accordance with Service Bulletin (SB) 093-27-128, with indicators having flashing red warning lights when the slat system position disagrees with the flap-commanded position in those L-1011 airplanes that are not already in compliance with the SB. (A-97-98)

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

By: 
Jim Hall
Chairman

¹Safety Board staff found that all 50 L-1011-500 series airplanes and all 19 L-1011s operated by Cathay Pacific utilize the flap indicator incorporating the red slat/flap disagreement warning light. There are about 180 L-1011s that are not in compliance with the SB.