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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 19, 1986

In reply refer to: A-86-128 through -130

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

On November 13, 1986, at 1225 e.s.t. a Lockheed L-1011 operating as Delta Airline Flight 194 en route from Atlanta, Georgia, to Newark, New Jersey, was cleared for an ILS approach to runway 04 and then to circle and to land on runway 29. Flight 194 made the approach and landed and then turned onto a parallel taxiway. The tower operator observed what appeared to be smoke coming from the right wheel brakes and notified the flightcrew. It became evident that the smoke was actually fuel vapor and that fuel was leaking from the right wing near the landing gear. The engines were shut down, and the passengers and crew deplaned. Fuel continued to leak from the right main fuel tank. There were no reported injuries and no fire.

A witness who observed flight 194 land stated that he saw what appeared to be a cloud of smoke coming from the right main landing gear while the aircraft was still about 10 feet in the air, and that the subsequent touchdown did not appear to him to be hard. He emphasized that the cloud of smoke could have been a fuel stream and that the cloud appeared while the aircraft was still airborne.

Examination of the airplane revealed substantial damage to the right wing, specifically to the aft main wing spar, and fuel tank. Further examination of the structure disclosed a complete separation of the rear spar between the wing root and the landing gear attachment.

When the rear spar was viewed looking forward, it was noted that the web had separated along an approximately 45° angle with extension of the failure between the upper spar cap near the wing root and a point on the lower spar cap approximately 5 feet outboard of the wing root.

Although the investigation is continuing, preliminary inspection of the spar fracture by a Safety Board metallurgist disclosed an approximately 6 3/4-inch long aggregate fatigue crack in the spar web emanating from a Hi-Lok fastener hole used to attach a doubler forward of the web. In the inboard and outboard directions, this doubler overlaps two vertical "Z" shaped stiffeners and is an intergal reinforcement around the fuel fill valve hole in the spar web.

Initiation of the fatigue crack was indicated as being on the forward surface of the spar web adjacent to and on each side of the lower inboard 5/16-inch Hi-Lok fastener hole attaching the forward (inner) doubler. The fatigue initiated in an area which is not visible from the forward side of the spar because it is masked by the doubler.

Initial propagation of the fatigue cracks was aft through the web thickness and then in opposite directions away from the fastener hole. The fatigue cracks initiated approximately 4 1/4 inches inboard and up, and about 2 3/8 inches outboard and down from the fastener hole.

The fatigue crack in the latter stages appeared to be growing rapidly which is typical of a crack reaching a critical size. Because of this, the total fracture of the spar could have stemmed from the fatigue region under normal loading conditions.

The airplane is an early production L-1011 and had accrued 37,445 flight hours and 21,788 flight cycles. The Safety Board has determined that about 93 other L-1011 airplanes have over 30,000 hours flight time. The Safety Board has not yet evaluated the approved inspection procedures for L-1011 wing structure; however, with the existence of the damage on this airplane, the Safety Board believes that a review and revision of inspection procedures are needed.

Since weakening of primary wing structure from the aforementioned condition is critical to operations of the airplane within the design flight envelope, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require an immediate inspection using methods adequate to detect fatigue cracking of the wing rear spar with emphasis on the spar web at the lower inboard fastener hole for the forward side doubler reinforcing the fuel filler valve hole of all Lockheed L-1011 airplanes having more than a conservatively established threshold of both flight hours and flight cycles; the threshold should be predicated upon the time and cycles on the accident airplane. (Class I, Urgent Action) (A-86-128)
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> Revise the approved inspection programs for Lockheed L-1011 airplanes as necessary to establish inspection thresholds, intervals, and methods which are adequate to detect fatigue cracking of primary wing structure. (Class II Priority Action) (A-86-129)
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> Notify foreign certification authorities about the circumstances of this accident and the need for remedial actions. (Class I, Urgent Action) (A-86-130)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.

Patricia A. Goldman for

By: Jim Burnett
Chairman