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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 4, 1988

In reply refer to: A-88-49

Honorable T. Allan McArtor
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July 31, 1987, a Flying Tigers Boeing 747-245F, operating as scheduled cargo flight 66, was on approach to Hong Kong International Airport. Just before reaching the outer marker, the flightcrew selected full flaps (30°). Immediately afterward, the flightcrew heard a loud bang, and the airplane rolled to the left and yawed. The flightcrew noted that the indicator for the left inboard flaps read 20°. Engine thrust, aileron, and rudder controls were used to stabilize the airplane. In addition, the flap control was moved to retract the flaps to the 20° position. The touchdown was accomplished at approximately 180 knots airspeed. Ten tires deflated from overheat after the airplane was taxied to the gate.

Inspection of the left inboard flap assembly showed that the flap was retained on the wing only by the jackscrews and fail safe links. Both the inboard and outboard carriage spindles, the main load-carrying members between the flap assembly and the flap tracks, had broken. Other damage consisted of bent and broken flap push rods, puncture damage to the lower surface of the midflap, and a spanwise crack in the foreflap. A hard-landing inspection also revealed a crack in the nose wheel well. Investigation of this incident is continuing.

A metallurgical examination of the two fractured spindles was performed at the Boeing Materials Technology Laboratory. The examination disclosed that the spindle fractures stemmed from small stress corrosion cracks emanating from corrosion pits on the spindle surfaces that mate with the press fit sleeves. The inboard spindle fracture, which occurred at the aft support bearing journal location, contained heavy oxidation indicating it had been fractured for some time before the airplane was landed at Hong Kong. The loud bang during the attempted landing probably was the result of the outboard spindle breaking at the forward journal location. The spindles had been modified in accordance with the sleeve design outlined in Boeing Service Bulletin 747-57-2133.

The airplane had accumulated 42,424 hours total flight time with 10,574 landings. At this time, it is not known whether the two carriage spindles had ever been overhauled. Flying Tigers routine maintenance program includes an inspection of the spindle journal area with the sleeves removed; however, the flap carriage assemblies were not scheduled for overhaul until about a year after the incident.

The only other known instance of inflight carriage spindle breakage occurred in 1980 on an Air India airplane; one spindle on the right inboard flap broke during landing in London. A complete investigation was not performed, but the information received from Boeing revealed that the spindle broke in the forward bearing journal location and that a corrosion zone was noted. Currently, Boeing 747 operators are not required to remove the bearing journal sleeves to perform a complete inspection of the carriage spindles (eight total) on both the inboard and outboard flaps (four total). A survey of domestic Boeing 747 operators revealed a variance of in-house inspection policies that range from no removal of the journal sleeves to removal of the sleeves between 18,000 and 30,000 hours of aircraft service. Not all airlines kept track of the service time of the carriages. The operators who periodically removed the sleeves to examine the spindle surface mating with the sleeves reported typically finding pitting corrosion of varying degrees on the surface; no fractured or cracked carriage spindles were reported. Rework of the corroded areas has been successful and, to date, no carriage spindles have been rejected. Boeing indicated that it had received reports of five spindles found during ground inspection which had fractured through the aft threaded end (behind the aft bearing journal) of the spindle.

The Safety Board is aware of the Federal Aviation Administration's airworthiness directive, docket No. 88-NM-05-AD, amendment 39-5831, for inspecting the flap carriage spindles. This airworthiness directive requires repetitive visual inspections for cracks in the forward and aft journal areas of each trailing edge flap carriage area but does not specify removal of the spindles and journal sleeves. The interval of visual inspection is not to exceed 3 months. However, a visual inspection without removing the bearing journal sleeves is inadequate. Even a completely fractured aft journal, since it is hidden by the bearing, may go undetected in a visual examination. Periodic inspection of the carriage spindles is necessary so that the spindles will operate safely. The journal sleeves should be removed, all corrosion damage should be completely removed, and a magnetic particle inspection should be completed to check for stress corrosion cracks. Service history suggests that the 25,000- to 30,000-hour interval may be adequate. Overhaul repair procedures for both the inbound and outboard carriage assemblies are outlined in Chapter 27-51-81 and 27-51-75, respectively, of the Boeing Overhaul Manual.

The Safety Board is concerned that other high-time operating Boeing 747 aircraft may have corrosion damage in flap carriage spindles in the areas mating with the bearing journal sleeves and that this corrosion damage can lead to stress corrosion cracking and spindle breakage. The corrosion damage could result in loss of flap integrity and subsequent degradation of airplane handling performance, such as that experienced by Flying Tigers.

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

> Issue an airworthiness directive that requires operators of all Boeing 747-100 and -200 airplanes with inboard and/or outboard flap carriage spindles having more than 25,000 hours of service to periodically remove and inspect the spindle areas beneath the bearing journal sleeves on all inboard and/or outboard flap carriage spindles for evidence of corrosion and cracking; to properly rework corrosion-affected areas of the flap carriage spindles; and to reinstall bearing journal sleeves on

crack-free flap carriage spindles with procedures that will assure maximum corrosion protection of the spindles. (Class II, Priority Action) (A-88-49)

BURNETT, Chairman, KOLSTAD, Vice Chairman, and LAUBER and NALL, Members, concurred in this recommendation.

By: Jim Burnett
Chairman