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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: January 6, 1981

Forwarded to:

Honorable Langhorne M. Bond
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-1 through -5

A Lockheed L-1011-200 aircraft operated by a foreign carrier recently experienced an in-flight failure of a main landing gear inboard wheel flange. The failure caused major damage to flight control, electrical, and hydraulic systems, caused major damage to the aircraft structure, and resulted in explosive decompression of the cabin. There were two fatalities. Members of the FAA technical staff have been working closely with the National Transportation Safety Board's staff to determine the nature of the problem and the corrective actions required to prevent similar occurrences.

The continuing investigation has determined that the failed wheel was a B.F. Goodrich part No. (P/N) 3-1365, serial No. (S/N) 185. Information from Goodrich and Lockheed disclosed that Goodrich wheels P/N 3-1311-3 and P/N 3-1365 were both qualified to technical standard order (TSO) requirements for use on L-1011 aircraft having a maximum gross takeoff weight of up to 460,000 pounds. Domestic air carrier users of the L-1011 have reported a significant number of fatigue-related failures of the P/N 3-1311 wheels, but the P/N 3-1365 wheels have had a satisfactory service history. Goodrich warranty provisions, the relative service histories, and Goodrich Service Bulletin No. 369 all fostered the belief that the P/N 3-1365 wheels were stronger than the P/N 3-1311 wheels. Consequently, most operators use only the P/N 3-1365 wheels on those L-1011 aircraft operating at high gross weights.

Goodrich Service Bulletin No. 369 states that the thicknesses of P/N 3-1365 wheel outer flanges up to S/N 1404 are 0.490 to 0.550 inch. However, the Safety Board has learned from Goodrich that it manufactured an early quantity of wheels given P/N 3-1365 which were dimensionally and materially identical to the P/N 3-1311 wheels. Subsequent engineering drawing changes strengthened the P/N 3-1365 wheel by including thicker outer flanges, anodizing, and shot peening. Goodrich initially stated that the first flange dimensional change to the P/N 3-1365 wheel was effective on S/N 165. However, a postaccident laboratory examination disclosed that the outer flange of the failed wheel, S/N 185, measured less than 0.470 inch, which is below the minimum tolerance of 0.490 for the strengthened P/N 3-1365 wheel. The Service Bulletin does not mention that an early quantity of P/N 3-1365 wheels were manufactured before the engineering changes were incorporated.

Goodrich Service Bulletin No. 369 also states that the thicknesses of the P/N 3-1311 wheel outer flanges are 0.450 to 0.510 inch. According to engineering drawings submitted to the Safety Board by Goodrich, the specified dimensions for the P/N 3-1311 outer flanges are 0.410 to 0.470 inch. We believe that these errors are indicative of lax quality control procedures. The erroneous Service Bulletin information is misleading to the user and could contribute to confusion regarding the strength and durability of those wheels which are selected for use on L-1011 aircraft having higher gross weight configurations. Additional uncertainty as to the actual dimensional characteristics of the P/N 3-1365 wheels is created by the fact that Goodrich has previously indicated that P/N 3-1365 wheel assemblies up to about S/N 165 are the "same" as P/N 3-1311 assemblies. Disclosure of the less than 0.470 inch flange thickness on the failed S/N 185 wheel assembly thus creates a question as to exactly how many wheels with these dimensions are identified as P/N 3-1365 assemblies.

Discussions among the Safety Board staff, FAA staff, and the domestic air carriers have disclosed that all of the operators employ some inspection programs involving periodic eddy current or dye penetrant techniques. Before the accident it was generally believed that these programs were effective in detecting fatigue damage before catastrophic failure. However, the Safety Board remains concerned that the inspection requirements are not standardized and have not been uniformly effective in reliably detecting cracks prior to in-service failures. In fact, the foreign operator involved in this accident also used an eddy current inspection program and the failed wheel was inspected only 28 cycles before the accident. The Safety Board strongly believes that an effective inspection program is a vital element in the prevention of wheel failures and that the procedures proven by industry experience to be effective should be identified and required to be implemented by all carriers.

Furthermore, the Safety Board notes from Service Difficulty Reports that wheel failures are occurring with nearly all types of commercial aircraft. Therefore, the Safety Board believes that action to establish more reliable wheel inspection procedures should not be limited to the L-1011 wheels.

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

> Issue an immediate Airworthiness Directive to require that operators of L-1011 aircraft at the next tire change or within 20 cycles, whichever is sooner, measure the flange thickness on all P/N 3-1365 wheels with serial number up to 1404 which have been used on aircraft with a gross takeoff weight of 430,000 pounds or more, and include in the Airworthiness Directive a requirement to remove all wheels with outer flange thicknesses of less than 0.490 inch and installed on aircraft operating at gross takeoff weights of 430,000 pounds or more. Further requirements should include at each wheel disassembly of all P/N 3-1365 and P/N 3-1311 wheels, an inspection in accordance with procedures which have been evaluated by the FAA and demonstrated by industry experience to be effective in detecting in-service cracking prior to failure. (Class I, Urgent Action) (A-81-1)

Initiate an immediate survey of B.F. Goodrich manufacturing facilities by a Quality Assurance Systems Analysis Review Team or equivalent to assure the manufacturer's compliance with current regulatory requirements governing production certification and specifically the issuance and approval of service bulletins, investigation and reporting of service difficulties, maintenance of appropriate production and inspection records, and coordination of service difficulties with primary airframe manufacturers. (Class I, Urgent Action) (A-81-2)

Require tire, wheel, and airframe manufacturers to publish and disseminate to all operators all engineering data necessary to determine the effect on fatigue life of aircraft wheels by increasing or decreasing tire inflation pressures. (Class I, Urgent Action) (A-81-3)

Establish a program with air carriers, wheel, and airframe manufacturers to determine effective nondestructive inspection techniques for the variety of aircraft and wheel combinations in air carrier service and require operators to implement effective inspection programs. (Class II, Priority Action) (A-81-4)

Expeditiously disseminate any required wheel inspection and service programs to all foreign civil aviation authorities with regulatory responsibilities over operators of U.S.-manufactured aircraft and equipment. (Class I, Urgent Action) (A-81-5)

KING, Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, did not participate.

By: James B. King
Chairman