

Log 1505

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: March 31, 1983

Forwarded to:

Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-83-12

On May 23, 1982, at Charlotte, North Carolina, a Cessna Model 404 airplane was landed with the landing gear retracted because the flightcrew could not extend the gear. The National Transportation Safety Board's investigation of the accident disclosed that the aluminum hydraulic tubing in the right wing had ruptured because of metal fatigue, resulting in complete hydraulic failure. Safety Board data indicate 14 similar hydraulic line failures during the past 4 years on this model airplane, some of which also resulted in gear-up landings.

Metallurgical examination of the failed tubing disclosed fatigue in its side wall at a bend in the line. Using a scanning electron microscope, investigators found fracture features indicative of fatigue cracking. Fatigue cracking had begun along the inside diameter of the tubing from numerous points of origin. Fatigue cracks had propagated toward and nearly through to the outside diameter of the tubing before the thin region on the outside of the bend broke when overstressed. The cracking in the tube occurred in line with the major diameter of the elliptical section which was produced when the tubing was bent externally during manufacture. The bend radius was less than 90°, and the elliptical section produced at the location of the fatigue cracking was considered normal for bendable tubing. No material defects were found in the tubing.

After eliminating defective material as an explanation for the fatigue cracking, and since the line had been in service for about 4,700 flight hours, the Safety Board concluded that the maximum stress exerted by the hydraulic pressure in the line at the bend must be near to the fatigue limit of the aluminum tubing, and when sufficient cycles of stress are imposed, the tubing will crack in fatigue. Currently, these lines are inspected as an on-condition item with no replacement service life or time specified.

Therefore, and since the Cessna Model 404 airplane is used frequently in commuter operations, the Safety Board recommends that the Federal Aviation Administration:

Review the design criteria for the aluminum hydraulic lines in Cessna Model 404 airplanes to determine that the fatigue limit of the tubing, the prescribed installation bend radii, and the cyclic loads do not result in an unacceptable margin of safety as to fatigue and failure of the hydraulic lines; if the margin of safety is not adequate, require that the hydraulic lines (1) be inspected at appropriate intervals by a method that

will reveal fatigue cracks in the lines, or (2) be replaced at a specified service life or time that will forestall fatigue failure of the lines.
(Class II, Priority Action) (A-83-12)

BURNETT, Chairman, GOLDMAN, Vice Chairman, McADAMS, BURSLEY and ENGEN, Members, concurred in this recommendation.

Francis H. McAdams
for By: Jim Burnett
Chairman