NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: June 16, 1977

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-77-40 through 42

On October 17, 1976, a Bell 212 helicopter, N398EH, lost directional control and crashed during a landing approach to Natrona County Airport, Casper, Wyoming. The rotorcraft was new and had accumulated only 27 hours. Investigation of the accident revealed that the loss of directional control was caused by failure of the No. 4 section of tail rotor drive shaft, P/N 204-040-620-3; the failure was caused by torsional overstress.

Although no material or manufacturing discrepancies were found, a review of the Bell 212 service history indicates three previous failures of the same shaft section on helicopters operated by foreign countries. All failures were associated with reported main rotor overspeeds caused while operating one of the PT6T-3 engine power sections in the "manual" fuel-governing mode. Although no overspeed report or physical evidence of overspeed was noted during disassembly and inspection of the engines after the accident, we suspect that an overspeed may have occurred.

The Bell 212 was originally certified with P/N 204-040-620-3 tail rotor drive shafts installed, which were statically balanced when manufactured. Subsequently, Bell developed the expertise to dynamically balance the shaft; the procedure was approved by the FAA and the part number was changed to 204-040-620-5. All failures to date have been the -3 statically balanced shafts.

At the request of the National Transportation Safety Board and the FAA's Southwestern Region, the manufacturer began an extensive dynamic test program to include both 212 tail rotor drive shaft systems. The testing was conducted to ascertain if the analytical data on the tail rotor drive shaft's critical speed was correct; the data were submitted at the time of certification to show compliance with FAR 29.923 (rotor drive system and control mechanism tests) and FAR 29.931 (shafting

critical speed). Results of the tests indicate that the actual critical speed of both the statically balanced and the dynamically balanced shafts occurs at 115 percent of main rotor speed, rather than the analytically determined speed of 131 percent.

Damage to the failed shaft section from the Casper, Wyoming, accident was duplicated during one test run at 114 percent when the shaft yielded and contacted the tail cone structure. Although the critical shaft speed of 115 percent main rotor speed is 15 percent above the recommended "power on" limit and 11.5 percent above the "power off" limit, the margin of safety previously assumed is reduced substantially.

We are aware that Bell is continuing these tests and is investigating design changes to increase the rotor speed at which the critical speed is obtained in the tail rotor drive assembly. As an interim measure, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Operations Bulletin to all operators of Bell 212 helicopters and all other Bell models with P/N's 204-040-620-3 or 204-040-620-5 tail rotor drive shafts installed warning them to use caution when operating in flight regimes conducive to main rotor overspeed, particularly engine operations involving "manual" fuel governing, since the tail rotor drive shaft may fail if a main rotor speed of 115 percent is approached. (Class I--Urgent Followup) (A-77-40)
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> Issue a Maintenance Alert Bulletin to inspect the tail rotor drive system installation, particularly the No. 4 section, for evidence of shaft yield or tail-cone structure contact if the main rotor speed has exceeded 110 percent. (Class II--Priority Followup) (A-77-41)
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> Revise the applicable parts of FAR 29.923 and 29.931 to require manufacturers to demonstrate 120 percent rotor system overspeed by driving the power train with an external power source, if installed engine power turbine speed (N_2) limits preclude meeting this requirement. (Class II--Priority Followup) (A-77-42)

TODD, Chairman, BAILEY, Vice Chairman, McADAMS, HOGUE, and HALEY, Members, concurred in the above recommendation.

By: Webster B. Todd, Jr.
Chairman