

Log 1921



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 8, 1987

In reply refer to: A-87-29

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

On March 9, 1986, a Hughes 500D (now McDonnell Douglas Helicopter Company model 369) ^{1/} experienced an inflight failure of the main transmission output pinion gearshaft. During the ensuing autorotation landing, the aircraft was substantially damaged, and the student pilot was seriously injured; three other occupants of the aircraft were not injured.

Metallurgical examination of the output pinion at the Safety Board's Materials Laboratory revealed a fracture between the forward bearing journal and the toothed gear section of the output pinion gearshaft, p/n 369D25125. Evidence of progressive fatigue cracking was found on a large portion of the fracture surface. The fatigue crack had initiated in the journal-to-shoulder radius, a simple fillet radius, which measured between 0.022 and 0.024 inch. This radius value was within the manufacturer's specified limits (0.020 to 0.040 inch), which were in effect at the time of the original manufacture of this pinion.

Further research established that the size and configuration of the journal-to-shoulder radius had been changed by revision "E" (incorporated by Hughes Engineering Order 135599, December 1977) of the pinion engineering drawing, p/n 369D25125, after the manufacture of the pinion involved in the accident. The newer design requires a 0.05 to 0.07 inch undercut relief radius configuration in lieu of the previous simple fillet. Also, Hughes Engineering Order 135600, issued concurrently, increased the applicable area of shot peen coverage to include the radius area. Both changes were made to increase the fatigue resistance of the pinion by reducing the stress concentration at the modified radius and by inducing compressive stress through shot peening. These design changes have not been made effective for previously manufactured pinions.

Although no other accidents have been attributed to a failure of the pinion from 1974 to 1984, representatives of McDonnell Douglas Helicopter have indicated that there have been four fatigue failures of these pinions. All of the fatigue failures initiated in the simple journal-to-shoulder fillet radii.

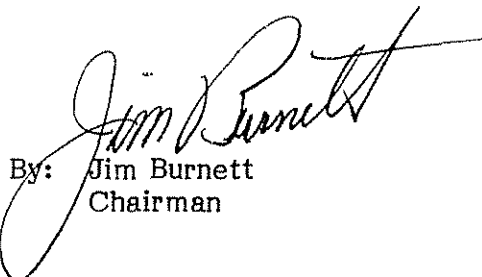
^{1/} NTSB Field Accident Report: BFO86FA018. Accident Brief: File No. 1286.

The Safety Board believes that there is a significant number of pinions with simple fillet radii between 0.020 and 0.040 inch in service, and that these pinions are subject to fatigue failures, which may result in damage to the helicopter and possible serious injuries to the passengers and crew.

As a result of its investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive to require inspection during the next overhaul of the main transmission, of Hughes 500D (McDonnell Douglas Helicopter model 369) aircraft with p/n 369D25125, main transmission output pinion gearshafts, to (1) identify pinions manufactured with simple journal-to-shoulder fillet radii; (2) inspect for cracks in the radii of these pinions; (3) remove any cracked pinions immediately from service; and (4) rework any uncracked pinions with simple fillet radii to the 0.05 to 0.07 inch undercut relief radius and shot peen as required by Hughes Engineering Orders 135599 and 135600, respectively. (Class II, Priority Action) (A-87-29)

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


By: Jim Burnett
Chairman

Brief of Accident (Continued)

File No. - 1286 3/09/86 MT. CRAWFORD, VA A/C Reg. No. N8352F Time (Lcl) - 1515 EST

Occurrence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation CRUISE - NORMAL

- Findings)
- 1. ROTOR DRIVE SYSTEM, COMBINING GEAR BOX - FATIGUE
 - 2. (STANDARD/REQUIREMENT) - MANUFACTURER
 - 3. ROTOR DRIVE SYSTEM, COMBINING GEAR BOX - FAILURE, TOTAL

Occurrence #2 FORCED LANDING
Phase of Operation DESCENT - EMERGENCY

Findings)
4. AUTOROTATION - PERFORMED - PILOT IN COMMAND

Occurrence #3 HARD LANDING
Phase of Operation LANDING - FLARE/TOUCHDOWN

- Findings)
5. TERRAIN CONDITION - RISING
6. LEVEL OFF - MISJUDGED - PILOT IN COMMAND

Occurrence #4 ROLL OVER
Phase of Operation LANDING - FLARE/TOUCHDOWN

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 1,2,3,6
Factor(s) relating to this accident is/are findings(s) 5