NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: May 23, 1977

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-77-30 and 31

Within the past year, four accidents in Enstrom helicopters have been caused by material failures. Before these recent failures, only two other accidents had occurred as a result of such failures--one, 6 years ago and another, 8 years ago. The National Transportation Safety Board believes that these failures, which are detailed in the attached table, demonstrate a need for immediate corrective action.

Three of the accidents were caused by fatigue failures in tail rotor spindle, P/N 28-15202. In all three of these failures, high-cycle reverse bending occurred in the seating radius for the blade grip bearing journals. Metallurgical examination of two spindles revealed tensile strengths below minimum specification for normal steel material. The spindles failed at 145 and 483 hours. Metallurgical examination of the third spindle, which failed at 1,222 hours, revealed that fatigue began because of improper machining.

Subsequent to the tail rotor spindle failures, the FAA issued two airworthiness directives which required that the parts be inspected for cracks and tolerance conformity. Although the 50-hour inspection interval may be sufficient to detect incipient cracks before they progress to failure, we are concerned that the past failures indicate a possible design certification deficiency as well as substandard quality control. The development of fatigue is evidence that the life of the part is sensitive to material properties, machining technique, and runout tolerance. Since the part is critical to safe flight of the helicopter, we believe that the fatigue-load and safe-life evaluations should have considered parts with worst tolerance. Such considerations might indicate a need to include the tail rotor spindle on the aircraft's critical parts list.

The fourth accident was caused by separation of a tail rotor blade grip, P/N 28-15017. Metallurgical examination revealed that the part was not heat treated to the proper specifications. The FAA's Aeronautical Center issued an emergency AD on March 2, 1977, to require that the part be replaced.

There have been other cases of manufacturing discrepancies on main rotor spindles, P/N 28-14282, and shafts, P/N 28-13104, that have been recalled by AD.

In view of the above, the National Transportation Safety Board believes that further corrective action is necessary and, therefore, recommends that the Federal Aviation Administration:

> Inspect the quality assurance program of the Enstrom Helicopter Corporation to insure that all materials, pieces, parts, and components used in the manufacture of helicopters comply with the certificating provisions of 14 CFR 21.33(b)(2) through (4). (Class--I Urgent Followup) (A-77-30)
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> Review the certification engineering data to insure that critical tolerance considerations are included in the fatigue replacement time evaluation of the tail rotor spindle as set forth in 14 CFR 27.571(c). In addition, in view of the low-time failures and possible fatal consequences, require that tail rotor spindle (P/N 28-15202) be added to the critical parts list. (Class--II Priority Followup) (A-77-31)

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

By: Webster B. Todd, Jr.
Chairman

Attachment

ENSTROM HEL ` `TER OCCURRENCES
- MATE FAILURE -

DATE	ACCIDENT	FAILED PART	DISCREPANCY	HOURS	FAA ACTION
5/10/68	F-28 N4462 Milwaukee, Wis.	Tail Rotor Spindle	Machining error	Unknown	None
9/23/70	F-28A N4894 Marianna, Pa.	Tail Rotor Gearbox	Porosity/casting hardness 15% too low	Unknown	None
4/4/76	F-28A N269Q Blythe, Ca.	Tail Rotor Spindle P/N 28-15202	Ultimate tensile strength 87 ksi Ave. Spec 90 ksi	145	None
8/9/76	F-28A N88RD Enon, Ohio	Tail Rotor Spindle P/N 28-15202	Machined radius too small Finish below drawing specification	1222	Issued AD 76-18-08 Sept. 9, 1976; check for cracks and runout every 100 hrs.
1/8/77	F-28C N537H Fallentimber, Pa.	Tail Rotor Spindle P/N 28-15202	Ultimate tensile strength 83 ksi Ave. spec. 90 ksi	483	Issued AD 77-04-04 2/28/77; inspection as above every 50 hours and after tail strike.
2/25/77	280C N594H Valparaiso, Ind.	Tail Rotor Blade Grip P/N 28-150013-3	Aluminum alloy 2024 not heat Treated. Soft.	6.1	Issued emergency AD dated 3/2/77 Substitute -11 Grip AD 77-06-04
Previous F-28A Accidents/Occurrences		Main Rotor Spindles P/N 28-14282	Machining deficiencies	Various	Issued AD 75-22-01 10/20/75, revised 7/1/76
		Main Rotor Shaft P/N 28-13104	Tool marks, surface irregularities, cracks	Various	Issued AD 75-26-19 11/28/75, superseded by AD 76-17-08, 8/6/76