



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

Log 2509

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Date: November 30, 1994

In reply refer to: A-94-189

Honorable David R. Hinson  
Administrator  
Federal Aviation Administration  
Washington D.C. 20591

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On November 20, 1993, a Hiller Aircraft<sup>1</sup> UH-12E helicopter, N161HA, crashed during an emergency landing about 8 miles southeast of Salinas, California. The pilot, who was the sole occupant of the helicopter, sustained minor injuries, and the helicopter sustained substantial damage. Preliminary inspection of the main rotor system revealed that the outboard tension-torsion (T-T) bar pin for one of the blades had fractured. The outboard T-T bar pin extends from the main rotor blade root fork and serves as an attachment point for the inboard end of the main rotor blade drag strut. Forces applied to the pin and drag strut by the main rotor blade root fork change the pitch of the main rotor blade. Fracture of the T-T bar pin causes a main rotor blade to rotate freely about the blade hub resulting in possible loss of control of the helicopter.

Metallurgical examination at the Safety Board's materials laboratory revealed that the head of the outboard T-T bar pin (P/N 51452) had separated, with the fracture intersecting the bolt through-hole where the drag strut is attached to the pin. Two fatigue cracks originated from corrosion pits along the surface of the bolt through-hole. One crack progressed through the entire wall cross-section on one side of the hole, and the other crack, which was located diametrically opposite the first, progressed nearly 25 percent through the wall cross-section. The through-hole contained areas of high luster indicative of wear from the T-T bar pin moving relative to the retaining bolt. The pin had accumulated 369.5 total airframe hours at the time of the accident, which was 73.5 hours after a 100-hour general inspection of the helicopter. The pin has a retirement life of 643 airframe hours.

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<sup>1</sup> Formerly known as Hiller Aviation.

On December 1, 1993, the operator of the accident helicopter performed an inspection on a second company helicopter, N5374V, also a Hiller UH-12E. Dye penetrant inspection of the disassembled outboard T-T bar pins revealed that a crack intersected the bolt through-hole in one of the two T-T bar pins. The cracked T-T bar pin was submitted to the Safety Board materials laboratory where it was found that a fatigue crack had originated from the bolt through-hole and propagated through about 80 percent of the wall cross-section. The pin had accumulated a total time of 489.4 airframe hours.

The Safety Board had previously investigated another accident that resulted from separation of the P/N 51452 T-T bar pin. The accident occurred on August 15, 1992, when a Hiller UH-12E helicopter, N9753C, crashed during an aerial application flight near Arvin, California. The pilot reported that during a procedure turn, the helicopter experienced an in-flight failure of the rotor system. The Board determined that fracture of the T-T bar pin was the result of a fatigue crack that originated at the bolt through-hole. The pin had accrued a total time of 641.5 airframe hours.

Cracking of the outboard T-T bar pin P/N 51452 was the subject of Hiller Service Letter (SL) 51-2, dated March 31, 1978. The SL advises owners of Hiller helicopter models UH-12D and -12E to perform visual inspections of the main rotor outboard T-T bar pin for proper alignment. If the outboard drag strut terminal, P/N 52119, and the blade trailing edge are misaligned by more than 1/16 inch, the SL recommends that the alignment be corrected by repositioning the T-T bar pin. The SL states that an improperly aligned T-T bar pin can cause the drag strut to put a large twisting moment on the head of the T-T bar pin and, in turn, this moment can cause cracking of the head of the T-T bar pin. The SL recommended that the inspections be performed within the next 25 airframe hours after receiving the SL or at the next No. 3 check,<sup>2</sup> whichever occurs first. In addition, the SL recommended that the head of the outboard T-T bar pin be inspected for cracks, by dye penetrant method, at the next and each subsequent No. 3 check (every 100 hours). T-T bar pins found to contain cracks are to be replaced with pins having the same part number.

The head of the T-T bar pin is attached to the inboard drag strut terminal by a bolt, nut, and two washers. Hiller Service Bulletin (SB) 51-9, dated April 8, 1983, addresses fretting corrosion<sup>3</sup> of the head of the T-T bar pin P/N 51452. The SB advises owners of models UH-12A through -12E, OH-23D, OH-23F, OH-23G, and all Hiller helicopter models converted by supplemental type certificates (STC) 178WE and 177WE to install shims between the flats of the T-T bar pin head and the clevis of the inboard drag strut terminal. According to the SB, this modification should reduce fretting corrosion between the T-T bar pin head and the clevis. In addition, the SB states that the disassembled T-T bar pins

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<sup>2</sup> An inspection that is performed every 100 hours. The procedures for this inspection are described in the Hiller service manual for the model UH-12 helicopter.

<sup>3</sup> A type of wear that occurs between tight fitting surfaces subjected to cyclic relative motion. It is usually accompanied by corrosion.

should be inspected, by dye penetrant method, and the alignment of the drag strut should be checked according to the instructions in SL 51-2. The SB highly recommends that the modification, dye penetrant inspection, and alignment check be accomplished at the next 100-hour inspection. The SB indicates that the aircraft log book should be updated to show that shims were installed according to the SB.

According to SB 51-9, there are two earlier versions of the T-T bar pin (P/N 51414-1 and P/N 51435 T-T) that are also subject to dye penetrant inspection. A representative from Hiller indicated that these P/N T-T bar pins were installed in early model Hiller helicopters and are similar in design to the P/N 51452 T-T bar pin. The representative also indicated that Hiller is not aware of any separations of these P/N T-T bar pins, but included dye penetrant inspection of these pins in the SB as a precautionary measure.

The operators of the N161HA and N5374V helicopters indicated that the T-T bar pins on Hiller helicopters were not routinely inspected by the dye penetrant method described in SL 51-2, and that no shims have been installed between the head of the T-T bar pin and the outboard drag strut terminal per SB 51-9. This inspection and installation are not required by the Federal Aviation Administration (FAA).

A review of FAA Service Difficulty Reports (SDR) for June 1974 through August 15, 1994, revealed reports of T-T bar pin separation on seven Hiller UH-12E helicopters and one Hiller UH-12D helicopter. The N161HA and N5374V helicopters are included in the SDR entries. One of the entries in the SDR indicated that three other T-T bar pins had fractured previously. The report did not indicate the number of Hiller helicopters involved. Another entry in the SDR indicated a second failure of the T-T bar pin in the fleet.

The Safety Board believes that the N161HA helicopter accident could have been prevented had the dye penetrant inspection been performed on the T-T bar pins during the last 100-hour inspection of the helicopter. A dye penetrant inspection was effective in detecting a crack in one of the two T-T bar pins from the N5374V helicopter.

Improper alignment and excessive play between the T-T bar pin and outboard drag strut terminal can introduce higher-than-normal operating stresses on the head of the T-T bar pin. In turn, these stresses can lead to fretting corrosion and cracking in the head area of the T-T bar pin. The Safety Board believes that these factors contributed to the premature separation of the T-T bar pin on the N161HA helicopter, which occurred 26.5 hours prior the next 100-hour inspection (No. 3 Check). High stresses and the likelihood of cracking on the head of the T-T bar pin can be reduced by properly aligning the head of the T-T bar pin with respect to the outboard drag strut terminal and installing shims between the head of the T-T bar pin and outboard drag strut terminal according to SB 51-9.

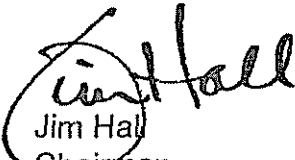
The Safety Board believes that if the instructions in the SB are followed, a dye penetrant inspection of the T-T bar pin at 100-hour intervals would be sufficient to detect cracking of the head of the T-T bar pin before becoming critical.

Findings of the metallurgical examination at the Safety Board materials laboratory and documentation in the FAA Service Difficulty Reports highlight the susceptibility of T-T bar pins to cracking and fracture. Nearly 1,000 UH-12 series and OH series Hiller helicopters are registered in the United States. Separation of a T-T bar pin in any of these helicopters may lead to extensive property damage, injury, or death. The accidents described in this letter demonstrate that the non-mandatory nature of the SL and the SB can result in the failure to detect cracks in T-T bar pins prior to their separation.

Therefore the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive for Hiller Aircraft helicopter models UH-12A through -12E, OH-23D, OH-23F, OH-23G, and all Hiller helicopter models converted by supplemental type certificates 178WE and 177WE to require that P/N 51452, P/N 51414-1, and P/N 51435 outboard tension-torsion (T-T) bar pins be inspected by dye penetrant method for cracks in the area of the bolt through-hole at 100-hour intervals. T-T bar pins found to contain a crack should be replaced with airworthy parts. The airworthiness directive should require checking and adjusting the alignment between the drag strut and T-T bar pins and installing shims at the inboard drag strut terminal location according to the Hiller Service Bulletin 51-9, dated April 8, 1983.  
(Class II, Priority Action) (A-94-189)

Chairman HALL, and Members LAUBER, HAMMERSCHMIDT, and VOGT concurred in this recommendation.

By:   
Jim Hall  
Chairman