



# National Transportation Safety Board

Washington, D.C. 20594  
Safety Recommendation

Log 2450

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**Date:** September 7, 1993

**In reply refer to:** A-93-114 and -115

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

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On May 13, 1992, the left main landing gear collapsed on a Piper PA-34-200, Seneca, as it was landing at Oxford Airport, United Kingdom. Neither occupant of the airplane was injured, but the airplane was severely damaged. The accident was investigated by the Air Accidents Investigation Branch (AAIB) of the Royal Aerospace Establishment in the United Kingdom. The AAIB has recently informed the National Transportation Safety Board of its concerns regarding this accident. The cause of the collapse of the left main landing gear was determined to be high-cycle fatigue cracking of the swivel pin that attaches the landing gear sidestay to the wing.

The airplane had accumulated about 3,235 flight hours. However, the records did not indicate the number of landings that had been made during that time. Metallurgical examination of the left main landing gear swivel pin indicated that separate fatigue cracks had grown from both the inboard and outboard edges near the blending radius of the shank. The reverse bending loads caused the propagation of the fatigue cracks until each had extended across about 30 percent of the shank cross-sectional area. The remaining 40 percent of the section failed in overstress. Examination found that the fatigue cracks originated from corrosion pits in the surface of the shank of the swivel pin and had grown over a large number of cycles. The cadmium plating was worn off the pin where it was in contact with a bushing, and relatively minor corrosion pitting was present.

The AAIB reported that this failure was virtually identical to another main landing gear collapse accident that occurred on August 17, 1989, involving a Piper PA-34-200 at Stansted Airport, United Kingdom. That airplane had accumulated about 3,895 flight hours. The investigation found that as in the May 13, 1992, accident, the swivel pin failed after high-cycle fatigue cracks originating at two sites propagated across about 50 percent of the pin cross section where the blending radius met the shank. Inspection of the swivel pin from the right landing gear also revealed two large cracks.

The main landing gear swivel pin forms the attachment between a bracket fastened to the forward spar of the wing and the gear sidestay, which consists of two links that are intended to provide over-center bracing of the landing gear in the down and locked position. The pin is made of cadmium-plated solid steel, with a 9/16-inch diameter shank. It is retained by a castellated nut that bears against a plain washer. The AAIB investigation determined that similar components are used on the Piper PA-28R and PA-32R. The AAIB reports that in later airplanes, the diameter of the swivel pin is larger.

The Safety Board has recently examined two main landing gear swivel pins from a Piper PA-24 that exhibited cracking consistent with fatigue. The design of the swivel pins on the PA-24 is essentially identical to that of the PA-34, PA-32R, and PA-28R. Metallurgical examination of the pins indicated that each pin had fatigue cracks on the inboard and outboard edges near the blending radius of the shank. The cracks were discovered during an annual inspection of the airplane. During the inspection, the inspector noticed side play in both main landing gear. Subsequent removal and dye penetrant inspection of the swivel pins by the inspector found that the pins were cracked. The airplane had accumulated about 4,280 flight hours. The Safety Board's examination of the pins found that the cracks were small and most likely only one of the four cracks was large enough to have been discovered by unaided visual inspection.

The Safety Board notes that there is no inspection requirement of the landing gear fitting to check for the presence of cracks in the swivel pin. The swivel pin shank cannot be inspected without removing it from the assembly. The service manual provides that play in the assembly can be removed through the use of shims. Therefore, a mechanic who finds excessive side play of the main landing gear would probably remedy the situation by using shims without inspecting the swivel pin to look for cracks. The Safety Board believes that hard landings and operating from runways with rough, uneven surfaces would cause the swivel pins to crack in

fatigue. The presence of excessive side play would cause the fatigue cracks to grow at an accelerated rate. However, the fatigue cracks can be present even without excessive main landing gear side play. Therefore, the Safety Board believes that the swivel pins should be inspected by dye-penetrant or other nondestructive method.

The collapse of one or both main landing gear during landing frequently results in substantial damage to the airplane with potentially serious consequences. The Safety Board's investigation found that several thousand retractable landing gear Piper airplanes are in service with the swivel pin design and most of these airplanes have been in service for many years. Therefore, the possibility of an incident or accident is relatively high.

The Safety Board believes that an initial nondestructive inspection should be accomplished on the swivel pin in Piper airplanes after they accumulate a specific number of flight hours and that repetitive inspections should be accomplished at set intervals thereafter. The Safety Board recognizes that only three cases offer a limited data base upon which to determine the initial inspection requirement. Additionally, how an airplane is used greatly affects the rate at which a swivel pin could fail. Operating in corrosive environments, on rough runways, or in training flights could shorten the life of the pin. Based upon available data, the Safety Board believes that an initial inspection of the pins after 2,000 hours in service is a reasonable and conservative approach. Additionally, a repetitive inspection cycle should be established to ensure that fatigue cracking of the swivel pins can be found before a failure occurs.

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


Issue an airworthiness directive to require, at the next 100-hour or annual inspection, a dye penetrant or other nondestructive inspection of the main landing gear swivel pins on all retractable landing gear Piper airplanes that have been in service for more than 2,000 flight hours and require that a repetitive inspection of the swivel pins be accomplished at appropriate intervals. (Class II, Priority Action) (A-93-114)

Issue a report in the General Aviation Airworthiness Alerts (Advisory Circular 43.16) to inform maintenance personnel of the potential of fatigue cracks in the main landing gear swivel pins and of the necessity to check the main gear for excessive side play during all annual inspections. If

excessive side play is found, a nondestructive inspection of the swivel pin should be accomplished. (Class II, Priority Action) (A-93-115)

Also the Safety Board issued Safety Recommendation A-93-116 to the Aircraft Owners and Pilots Association.

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in these recommendations.

  
By: Carl W. Vogt  
Chairman