

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR24LA084

MATERIALS LABORATORY

Factual Report 24-018

April 12, 2024

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A. ACCIDENT INFORMATION

Location: Goodyear, Arizona
Date: February 10, 2024
Vehicle: Cessna 172P, N52436
Investigator: Andrew Swick, AS-WPR

B. COMPONENTS EXAMINED

Number 3 connecting rod strap and cap pieces with hardware pieces, and number 4 connecting rod beam and strap portion with hardware pieces and bearing halves from a Lycoming O-320-D2J engine.

C. EXAMINATION PARTICIPANTS

Specialist Matthew R. Fox, Ph.D.
NTSB
Washington, DC

D. DETAILS OF THE EXAMINATION

An overall view of the submitted components as received is shown in figure 1. The number 3 connecting rod pieces consisted of two cap pieces and two strap pieces with fractured bolt pieces trapped in the strap pieces. The number 4 connecting rod pieces consisted of a beam and strap portion of the connecting rod with two fractured and trapped bolt pieces and the strap fractured at one side, an intact but gouged and deformed cap piece, and two deformed bearing halves. The threaded ends of the attachment bolts with intact nuts from the numbers 3 and 4 connecting rods were also received as shown in figure 1.

A January 26, 2024, entry in the accident airplane's engine maintenance logs associated with the last 100-hour inspection before the accident indicated the maintenance Hobbs meter read 1,786.9 hours, and the engine's time since new was 3,745.6 hours. An August 18, 2023, entry in the same log book noted the number 4 cylinder assembly was replaced with a new cylinder assembly kit. The August 18, 2023, entry indicated the maintenance Hobbs meter read 1,206.9 hours, the engine's time since new was 3,165.6 hours, and the engine's time since major overhaul was marked "N/A" (not applicable). At the time of the accident, the tachometer read 3,764.1 hours.

The four connecting rod bolts for the two connecting rods had irregular fractures on slant planes with deformation consistent with ductile overstress fracture. The strap fracture on the number 4 connecting rod showed matte gray fracture features on a portion of the fracture surface and smearing damage on the remainder, also consistent with ductile overstress fracture. The cap for the number 4 bearing was

largely intact but had impact damage on the sides and exterior faces and was generally flattened. The number 4 bearing halves were similarly intact but were also flattened. The Babbitt material on the interior faces of the number 4 bearings was substantially worn away, exposing the underlying copper layer across most of the interior surfaces.

Fracture surfaces on the cap pieces were examined and generally showed rough features consistent with ductile overstress fracture. Portions of the fracture had somewhat smoother features with curving boundaries, consistent with progressive fracture. However, the surfaces were relatively rough and represented a small portion of the cross-section consistent with relatively high cyclic stress levels.

After a preliminary examination, the strap pieces from the number 3 connecting rod were cleaned using an ultrasonic cleaner while submerged in a solution of Alconox detergent and warm water to remove oily deposits on the surfaces. The bearing contact faces for the strap pieces smooth reflective areas that were slightly tinted in gold and blue colors. According to the Wreckage Examination Summary Report, the corresponding number 3 connecting rod journal on the crankshaft showed thermal distress and mechanical damage.

The cleaned number 3 connecting rod strap fracture surfaces are shown in figure 2. Undamaged portions of the fracture surface had relatively smooth fractures with curving crack arrest lines, features consistent with fatigue. Radially-oriented ratchet marks were also observed consistent with multiple fatigue origins. Unlabeled brackets in figure 2 indicate the location of fatigue origins located at the outside surface of the strap adjacent to the connecting rod bolt head. Unlabeled arrows indicate fatigue crack growth directions, and the arrows point to crack arrest marks visible on the surface. The fatigue crack boundary was not determined due to post-fracture damage on the fracture surfaces.

Submitted by:

Matthew R. Fox, Ph.D.
Chief Technical Advisor - Materials

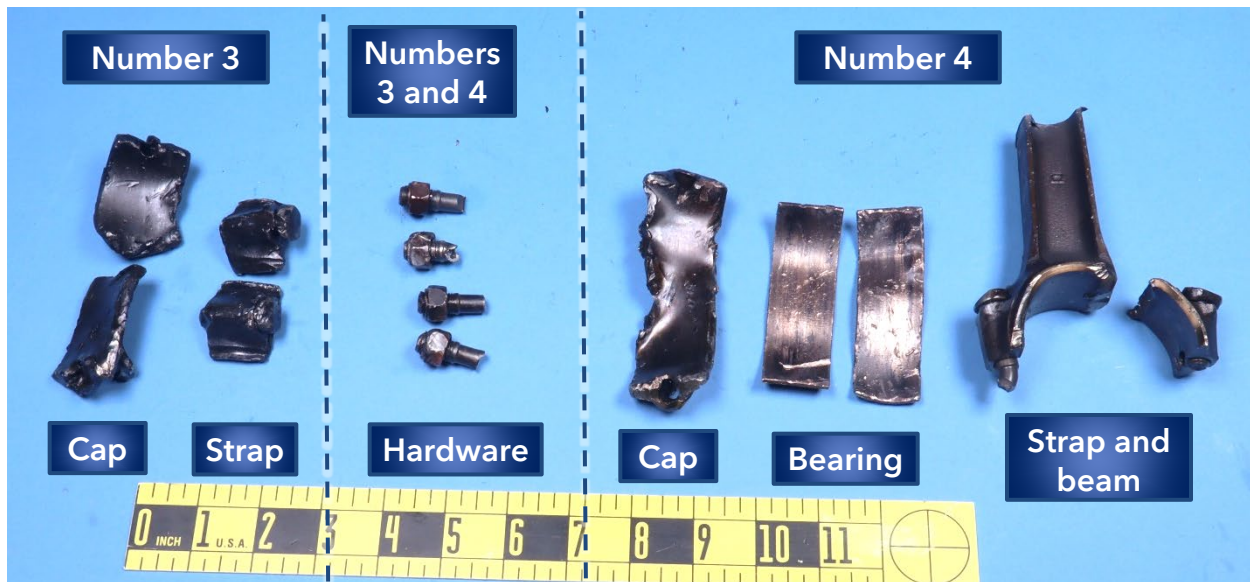


Figure 1. Overall view of the submitted components.

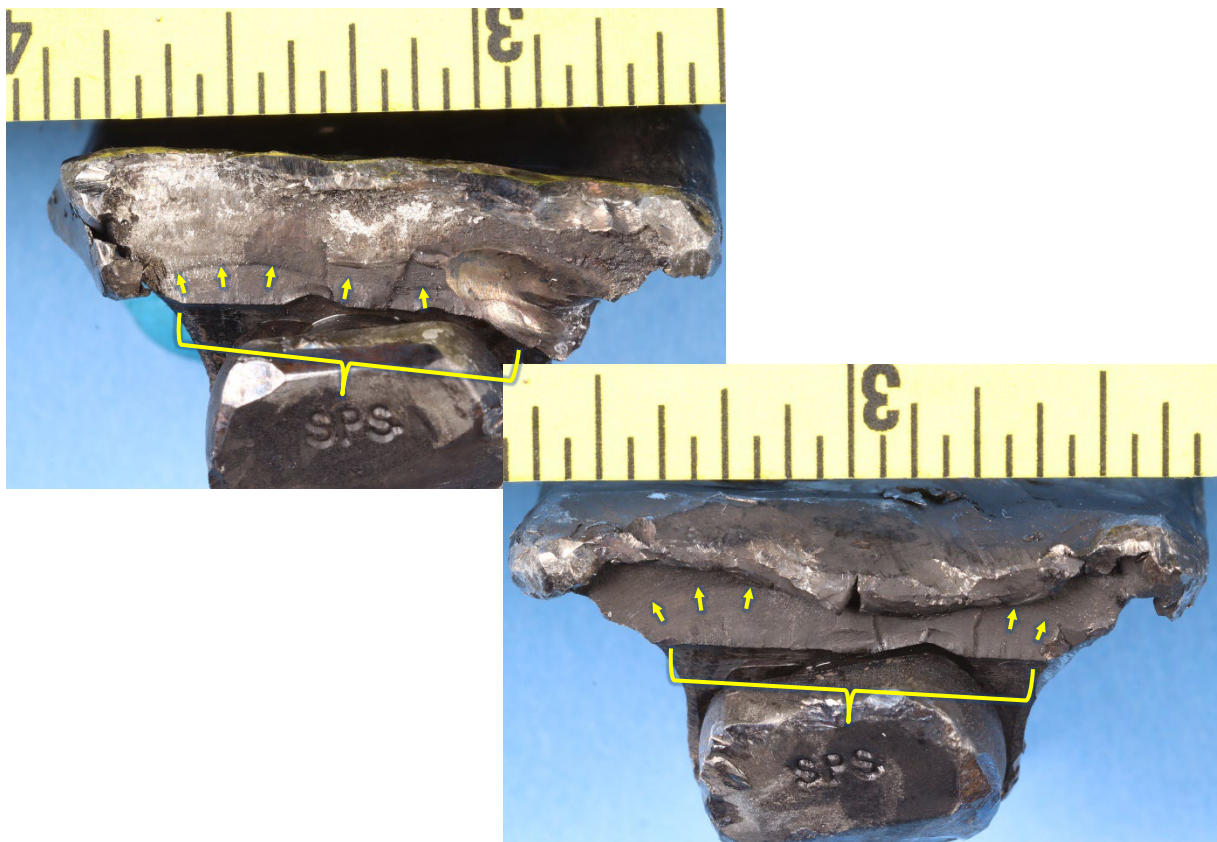


Figure 2. Close views of strap fracture surfaces for the number 3 connecting rod after cleaning. Unlabeled brackets indicate fatigue origin areas, and unlabeled arrows indicate the direction of fatigue crack propagation at the location of selected crack arrest marks visible on the surface.