

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



December 20, 2013

MATERIALS LABORATORY FACTUAL REPORT

Report No. 13-104

A. ACCIDENT INFORMATION

Place : Paris, Texas
Date : April 19, 2013
Vehicle : Piper PA-32, N82723
NTSB No. : CEN13LA233
Investigator : Aaron M. Sauer, AS-CEN

B. COMPONENTS EXAMINED

Pieces from 6 connecting rods assemblies from a Lycoming Engines IO-540 engine.

C. DETAILS OF THE EXAMINATION

An overall view of the submitted components is shown in figure 1. The connecting rod pieces are numbered in figure 1 in accordance with cylinder number. The number 3 connecting rod was fractured in the I-beam section of the connecting rod, and connecting rods 2 and 4 were fractured through the straps on each side of the rods. Two flattened connecting rod caps were also included along with multiple connecting rod nut and bolt pieces and connecting rod journal bearings. No evidence of heat tinting was observed on the components.

The intact connecting rods from cylinders 5 and 6 were marked "LW 13756". The connecting rod bolts were stamped on the heads with markings "SL 75060L FAA-PMA".

Fractures on connecting rods and bolts were examined visually and under an optical stereo microscope. The number 3 connecting rod was bent adjacent to the fracture surface, and fracture features were irregular and rough consistent with overstress fracture. A view of one of the strap fracture surfaces from connecting rod 2 is shown in figure 2. The fracture showed flat features with curving crack arrest lines, features consistent with fatigue. The fatigue features emanated from origin areas at the connecting rod bolt head cutout (arrowed locations in figure 2) and from the bearing face (bracketed areas in figure 2). The fatigue regions were relatively rough with multiple origins and step features, features consistent with low cycle (relatively high stress) fatigue.

Fracture surfaces on the opposite strap for connecting rod 2 and on one of the fractures in the strap for connecting rod 4 also showed crack arrest features consistent

with fatigue. Fatigue origins were located both at the edges of the bolt cutouts and at the bearing face. The fatigue features were relatively rough consistent with crack propagation under relatively high stress.

Fracture features for the remaining strap fracture on the opposite side of connecting rod 4 were mostly obliterated by post-fracture damage. Most of the remaining fracture features appeared relatively rough consistent with overstress fracture, but some evidence of curving crack arrest lines consistent with low-cycle fatigue were observed.

The threaded ends of several of the connecting rod bolts are shown in figure 3. The nuts on two of the bolt pieces were displaced toward the end of the bolt, and thread peaks between the nut and the grip were flattened. One nut was received separated from the bolt as shown in the upper image in figure 3. The final 2 threads on the nut were damaged consistent with bolt pullout, and the remaining threads were intact.

The fracture surface of the middle bolt in the upper image in figure 3 is shown in the lower image in figure 3. Curving crack arrest lines consistent with fatigue were observed emanating from one side of the bolt. A bracket in figure 3 indicates the approximate fatigue origin. The fracture features were relatively rough consistent with fatigue crack propagation under relatively high stress. As shown in the upper image in figure 3, the bolt with fatigue features was bent and showed necking (reduced cross-sectional area) adjacent to the fracture. Fracture in all other submitted connecting rod bolt pieces (including those not shown in figure 3) showed features and deformation consistent with overstress fracture.

The bearings showed evidence of impact damage, and several of the bearings were flattened. Babbitt material was observed on interior surfaces of all the bearing pieces, and no evidence of abnormal or excessive wear was observed. The back side of one of the flattened bearings is shown in figure 4. Thread impressions corresponding to contact with the threads of a connecting rod bolt were observed in the slot at one end of the bearing as indicated in figure 4. The thread impressions were oriented such that the axis of the bolt was generally aligned with the length of the slot.

According to the engine log books on April 4, 2013, the engine had spark plug maintenance, cylinder compression checks, an oil change, and a 100-hour inspection in accordance with the Piper Maintenance Manual. The engine had 1,080.7 hours time since major overhaul at the time of the maintenance. No abnormal particles were noted in the opened filter, and the engine was determined to be airworthy.

Matthew R. Fox
Senior Materials Engineer

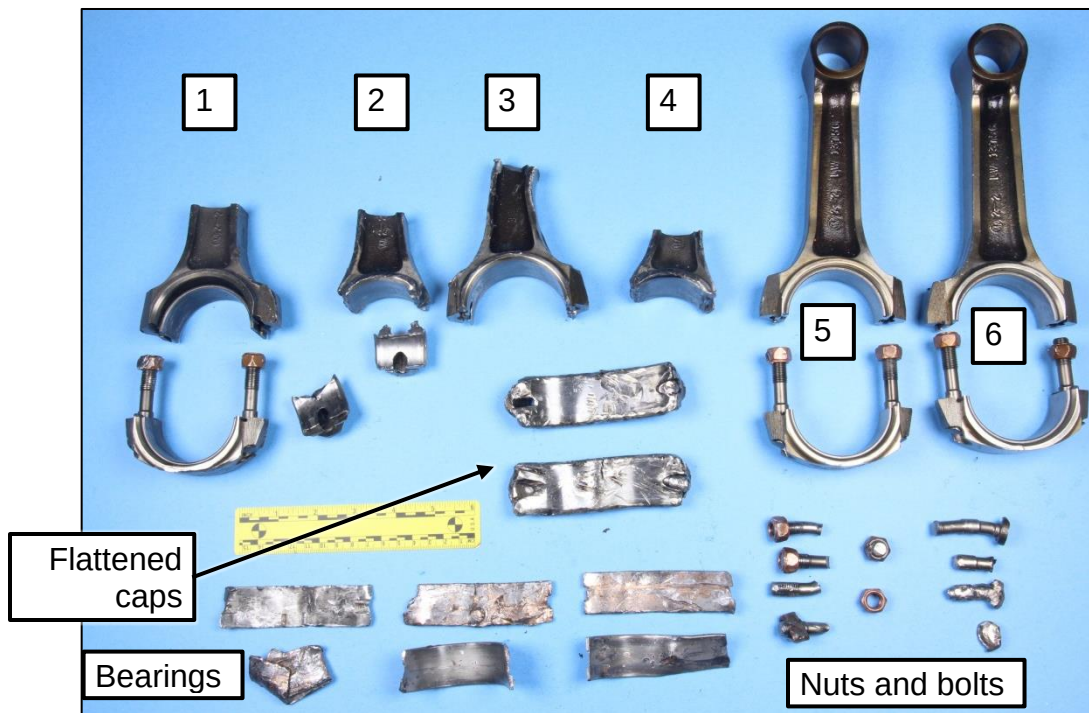


Figure 1. Overall view of the submitted components. Connecting rod pieces from cylinders 1 to 6 are positioned from left to right, and bearings and connecting rod nuts and bolts are shown along the bottom of the image.



Figure 2. Overall view of a fracture surface on a strap piece from the number 2 connecting rod. Arrows and brackets indicate fatigue origin areas on opposite sides of the fracture surface.

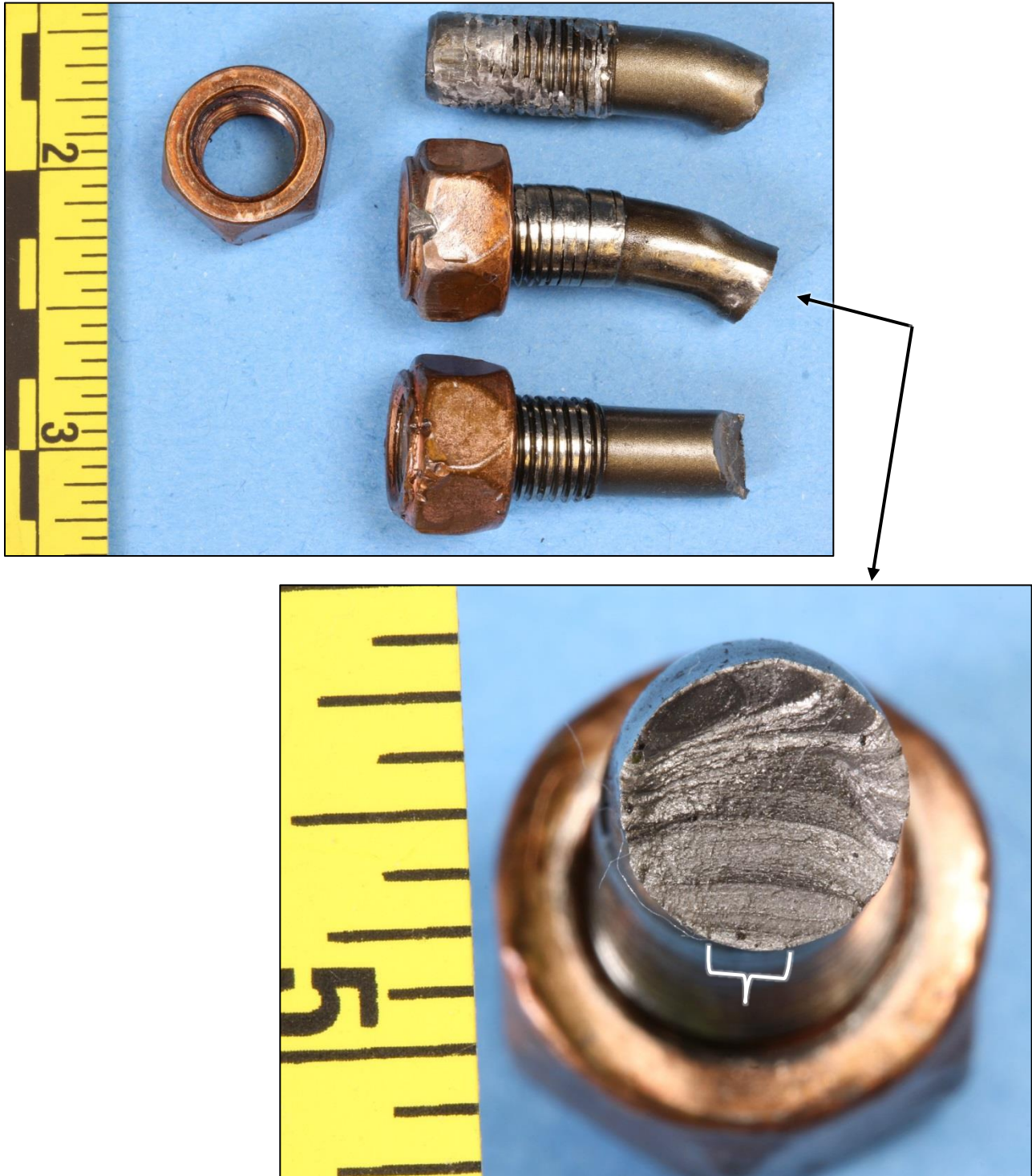


Figure 3. Close view of the threaded end of 3 of the connecting rod bolts and 3 nuts. Fatigue features were observed on one of the bolt fractures as indicated with an arrow and shown in the lower image. A bracket in the lower image indicates the fatigue origin area.



Figure 4. Views of the backside of one of the bearings showing thread impressions corresponding to contact with the threads of a connecting rod bolt.