NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

June 1, 2015

MATERIALS LABORATORY FACTUAL REPORT Report No. 15-060

A. ACCIDENT INFORMATION

Place	:	Hector, Arkansas
Date	:	October 14, 2013
Vehicle	:	Piper PA-32R-300 (N5605V)
NTSB No.	:	CEN14LA030
Investigator	:	Michael Folkerts (AS-CEN)

B. COMPONENTS EXAMINED

A separated crankshaft with an attached counterweight, one connecting rod journal bearing, and several bags containing broken components. Labeling on the bags indicated they contained pieces believed to be from a piston cooling nozzle, tappet, and counterweight bushing; one bag was labeled “crank”. One bag filled with very fine shavings was unlabeled.

C. DETAILS OF THE EXAMINATION

The separation in the submitted crankshaft occurred through the #8 cheek position, which is between the #5 and #6 piston[1], as shown in Figures 1 and 2. The fracture surface of the crankshaft separation is shown in Figure 3. The fracture surface has repeated crack arrest marks consistent with fatigue cracking. The fatigue cracking emanated from the cylinder journal where the #5 connecting rod mates. No gouges or wear was observed at the fatigue cracking initiation area and, as shown in Figure 4, no evidence of thermal distress was visible on the #5 connecting rod journal.

Labelling on the connecting rod bearing indicated it was in the #5 position on the crankshaft. The bearing halves were also identified as being installed in the cap or rod position on the connecting rod. Wear was observed on the inner diameter (ID) of the bearing halves. The wear was heavier on the rod half of the connecting rod bearing, where the Babbitt metal appeared to be worn through. Images of the wear on the ID of the #5 connecting rod bearing are shown in Figure 5. A ‘M03’ code, circled by red dots in Figure 6, was stamped on the sides of the connecting rod bearing halves, and indicates the connecting rod bearing is oversize to accommodate a mating crankshaft journal that has been ground/machined or reworked.

[1] The components for this investigation are from a Lycoming IO-540-K1G5D engine. In Lycoming engines the crankshafts journals are numbered from the front of the engine to the rear. Main and connecting rod journals are numbered independently.

The diameter of the #5 crankshaft journal was measured and compared to specifications for a part number (P/N) LW-12851 crankshaft, which was the P/N of the submitted crankshaft. The other connecting rod journals were also measured for informational purposes, and all of the measurements are presented in Table 1.

Table 1: Crankshaft connecting rod journal diameter measurements

	Connecting Rod Journals*					
	#1	**#2**	**#3**	**#4**	**#5**	**#6**
0 degrees	2.2488	2.2486	2.2490	2.2460	2.2461	2.2472
90 degrees	2.2460	2.2469	2.2480	2.2458	2.2461	2.2457
Average	2.2474	2.2477	2.2485	2.2459	2.2461	2.2465

* All measurements in inches

According to a Lycoming representative, the standard diameter of the connecting rod journal has a manufacturer's minimum and maximum diameter of 2.2485 inches and 2.2500 inches, respectively. The serviceable maximum permissible wear of the crankshaft journals, both connecting rod and main bearing journals, is minus 0.0015 inches on the diameter, which would make the minimum serviceable diameter of the connecting rod journal 2.2470 inches. In order for the connecting rod journal to mate properly with a 'M03' coded connecting rod bearing, the journal diameter would have to be polished or ground to 0.003 inches undersize; this means the connecting rod journal would have a minimum and maximum diameter of 2.2455 inches and 2.2470 inches, respectively, and including the allowable wear of 0.0015 inches means the minimum serviceable diameter of the connecting rod journal would be 2.2440 inches. The measured diameter of the #5 connecting rod journal met the specifications for a journal ground to 0.003 inches undersize.

The fracture surfaces on the remaining bagged components all had extensive impact damage. The features visible on the fracture surfaces were consistent with overstress. The pieces in the bag labeled "crank" were determined to be from the crankshaft counterweight pin boss. As shown in Figure 7, the pieces of the cooling nozzle found in the bottom of the sump did not have evidence of thermal distress.

Adrienne V. Lamm
Materials Engineer

Figure 1: Overall photo of the submitted components. The separation through the crankshaft is indicated by the red arrows. The white dotted line indicates the two halves of the connecting rod journal bearing.

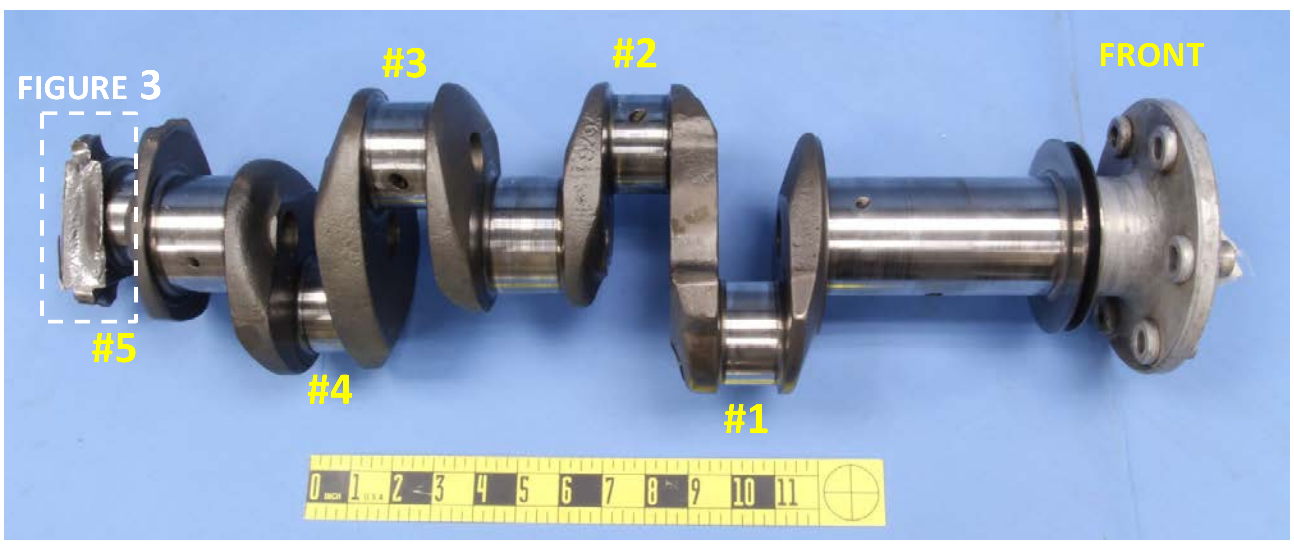

Figure 2: Overall photo of the separated crankshaft with the connecting rod journal numbered. The indicated fracture surface is shown in more detail in Figure 3.

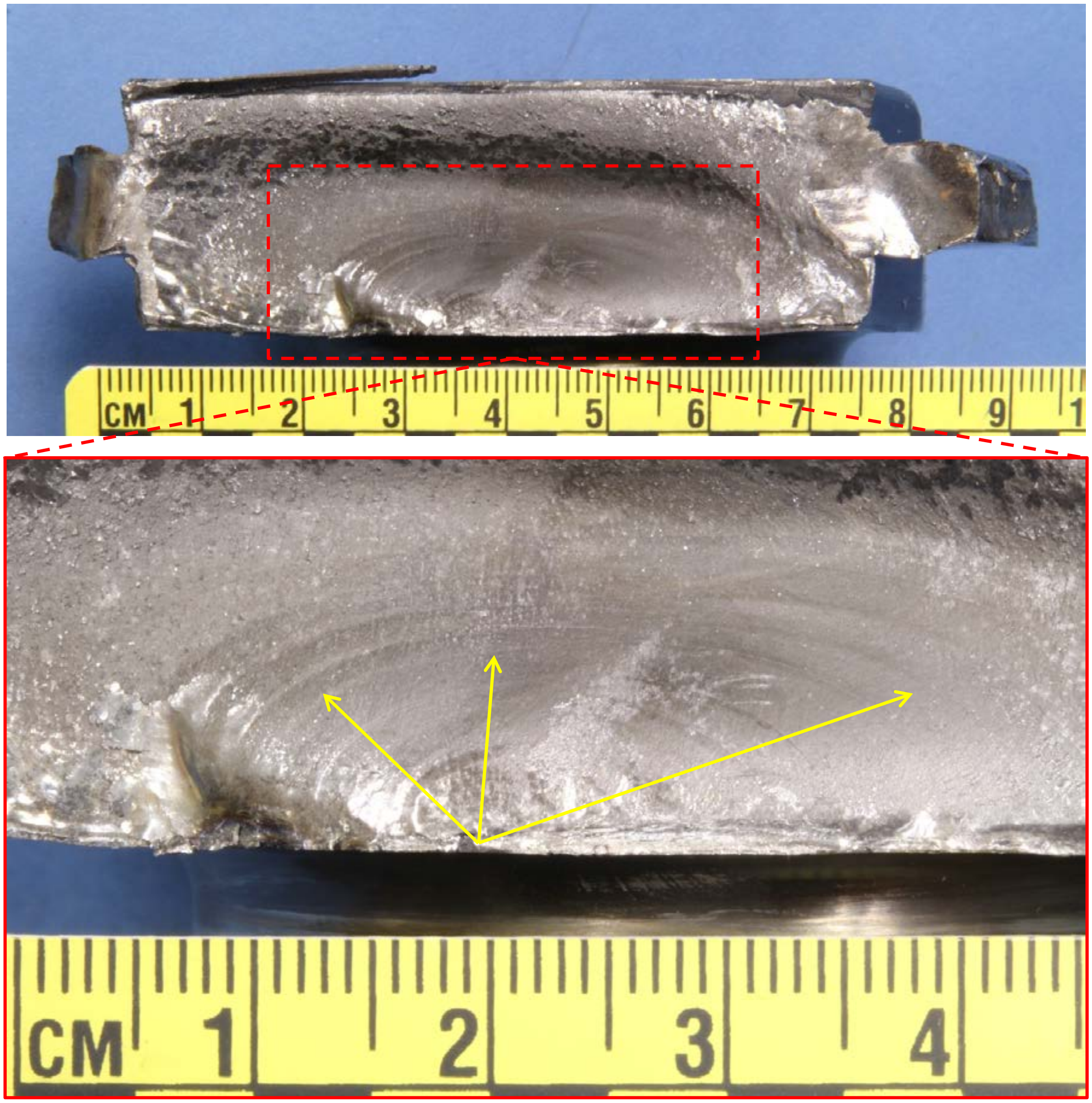

Figure 3: Close-up photos of the fracture surface of the crankshaft separation. The fracture surface had repeated crack arrest marks consistent with fatigue cracking. The fatigue cracking emanated from the connecting rod journal and propagated outward, as indicated by the yellow arrows.

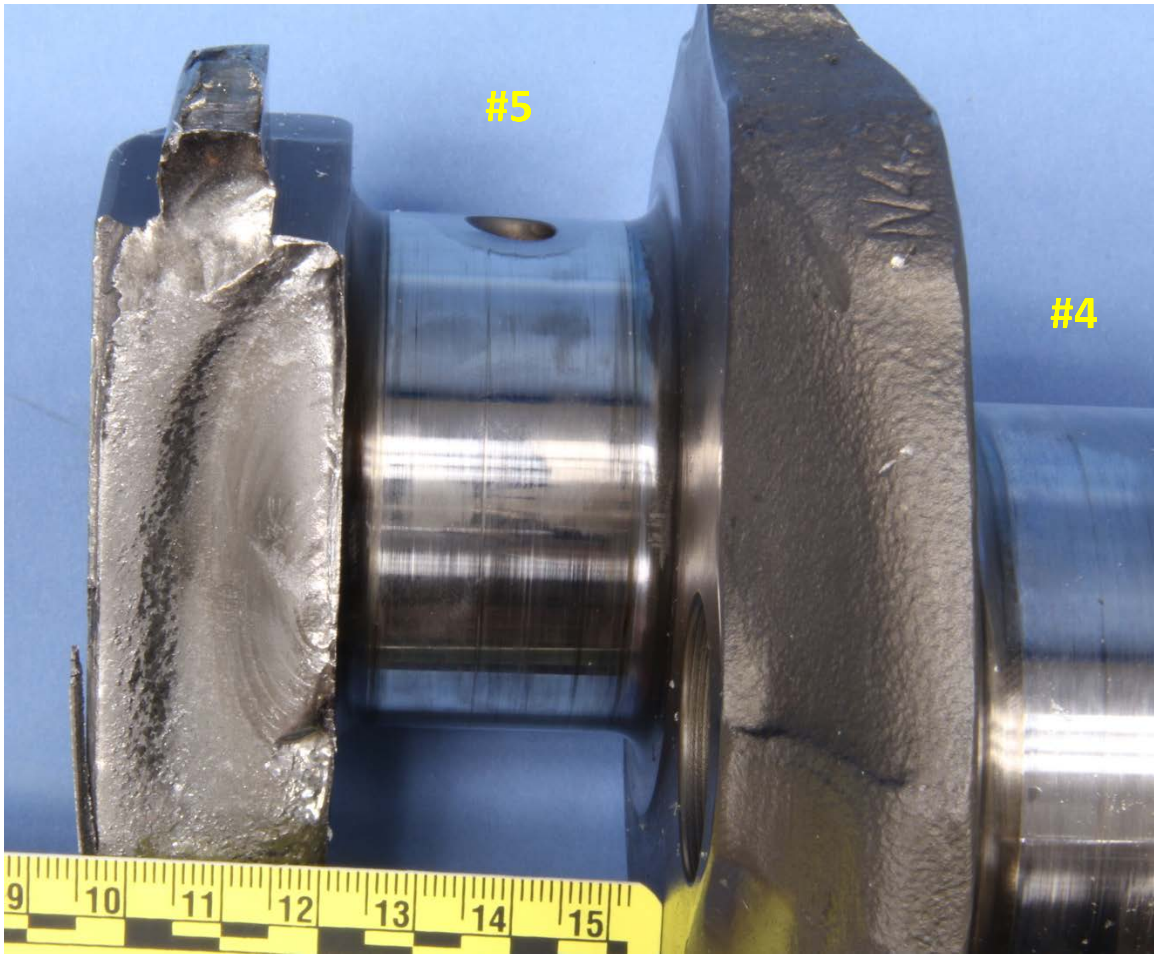

Figure 4: Close-up photo of the #5 connecting rod journal on the crankshaft.

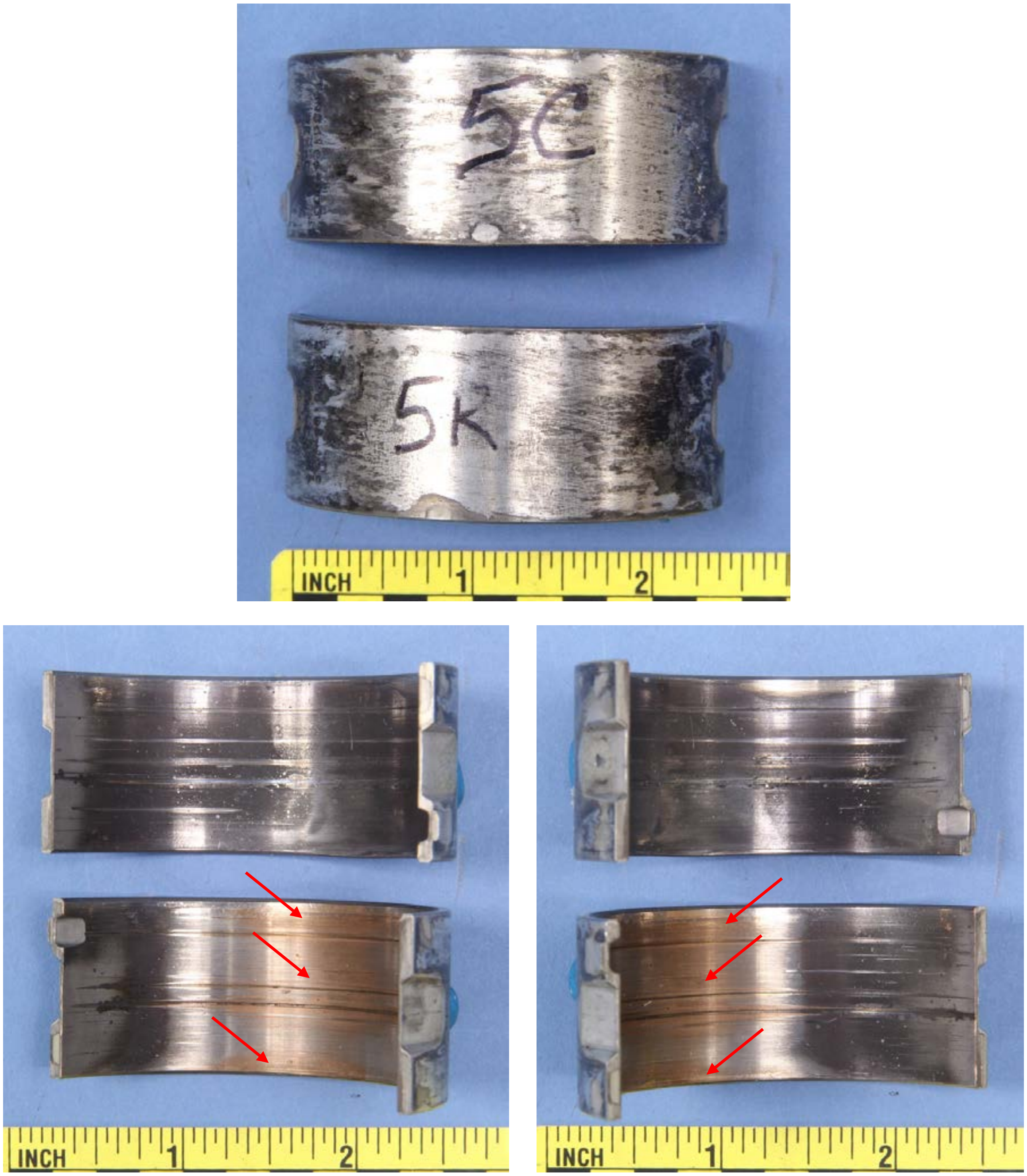

Figure 5: Overall photos of the connecting rod bearing. The red arrows point to areas on the ID of one bearing half where the Babbitt metal was worn through.

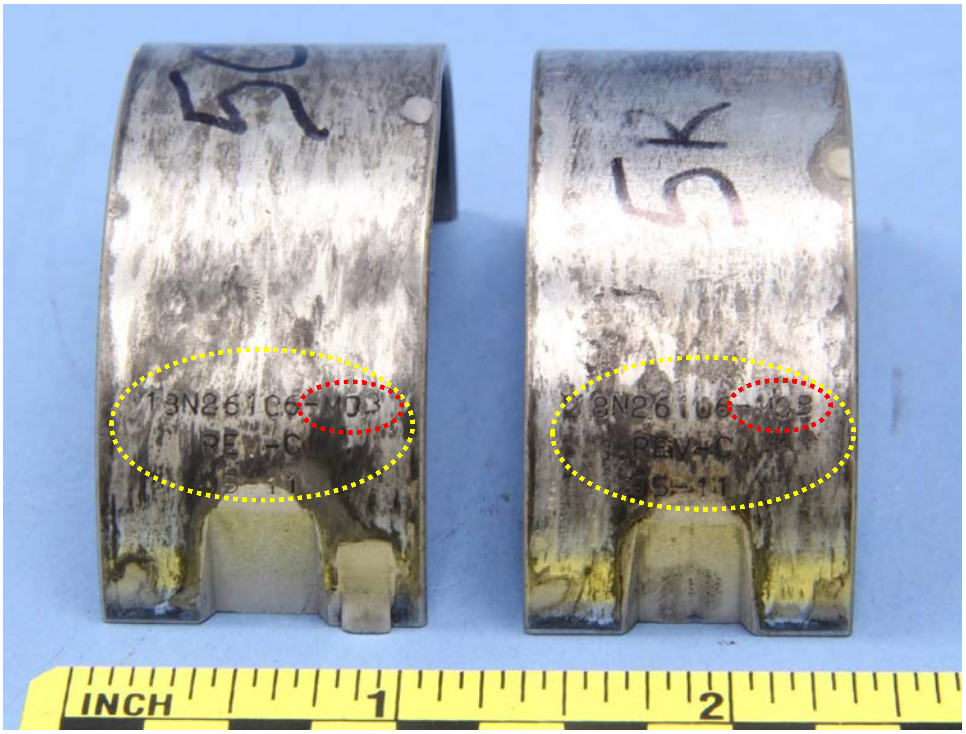

Figure 6: Close-up photo of the part markings (yellow dotted circles) and the ‘M03’ code (red dotted circles) on the sides of the connecting rod bearing.

Figure 7: Overall photo of the cooling nozzle pieces.