NATIONAL TRANSPORTATION SAFETY BOARD

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

June 16, 2021

MATERIALS LABORATORY FACTUAL REPORT Report No. 21-049

A. ACCIDENT INFORMATION

Place	:	Bethel, Alaska
Date	:	April 11, 2019
Vehicle	:	Piper PA-32-300, N4466T
NTSB No.	:	ANC19LA016
Investigator	:	Eric Swenson, AS-ANC

B. COMPONENTS EXAMINED

Fractured crankshaft and two halves of a bearing from main journal #3 of a Lycoming IO-540-K1A5 engine, serial number S237147-1.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a photograph of the as-received crankshaft and two halves of a bearing from main journal #3. The main journals, rod journals, and crank cheeks are numbered from the forward end to the aft end, starting with main journal #1 that is located adjacent to the propeller flange. The crankshaft fractured into three pieces. The fracture intersected main journal #3.

Bench binocular microscope examination of the crankshaft revealed crack arrest marks typical of fatigue cracking emanated from multiple origins at the surface of main journal #3 in the areas indicated by brackets “O” in figures 2 through 4. The fatigue origin area was located near the center of the main journal. The fracture face at the fatigue origin area exhibited evidence of blue, grey, and red tinting consistent with exposure to heat. The fracture features at the origin of the fatigue crack and other portions of the fracture were obliterated by post fracture relative movement between mating fracture faces. The fatigue crack propagated toward the core of the main journal where it split into two fatigue cracks. One fatigue crack propagated through the main journal to the diametrically opposite side of the main journal, see figure 1. The other fatigue crack propagated aft and through crank cheek #7, in the general direction indicated by arrows in figure 2.

The surface of main journal #3 exhibited evidence of severe mechanical damage such as circumferential abrasion, wear, galling and heat tinting (see figure 5). The surface also contained evidence of ladder cracking (multiple longitudinally oriented parallel cracks). The remaining rod and main journals showed no evidence of mechanical damage and heat

tinting. Rockwell hardness testing of main journal #4 produced an average hardness of 66HR30N, consistent with a surface that was hardened by nitride process.[1]

Examination of the two halves of the bearing from main journal #3 revealed the inner faces exhibited severe mechanical damage such as gouges and blue tint, similar to those found on the outer surface of main journal #3. The two halves of the bearing were severely deformed and the thickness of the bearings in many areas were severely reduced.

Frank Zakar
Senior Metallurgist

[1] This hardness value was above the typical hardness requirement specified for nitrided surface (64HR30N minimum) on Lycoming crankshafts.

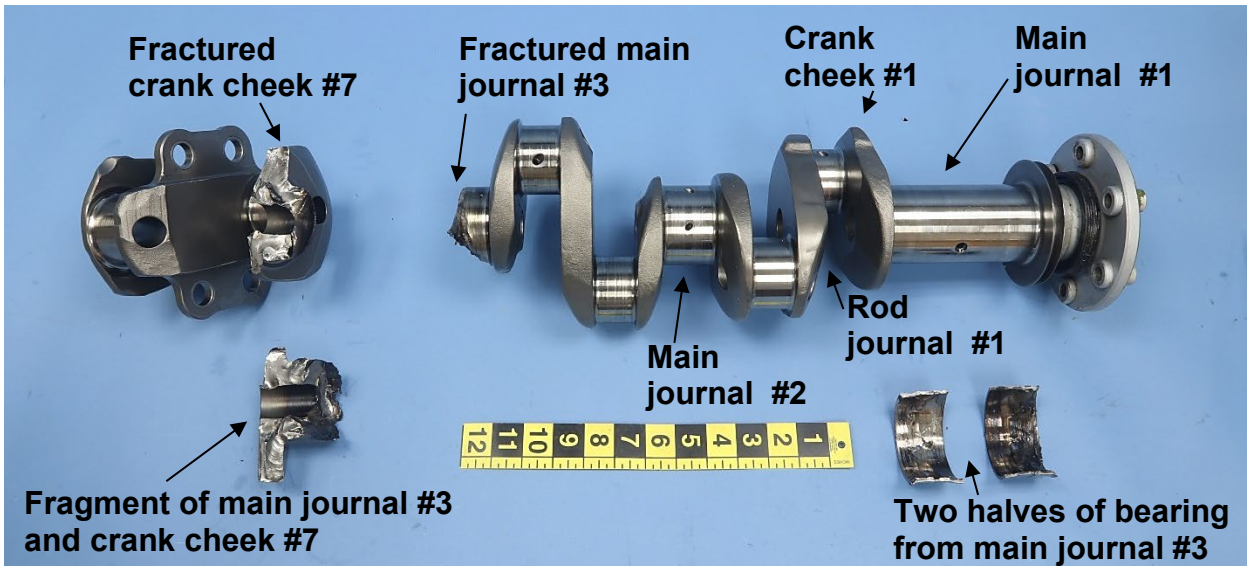

Figure 1. As-received crankshaft and two halves of bearing from main journal #3.

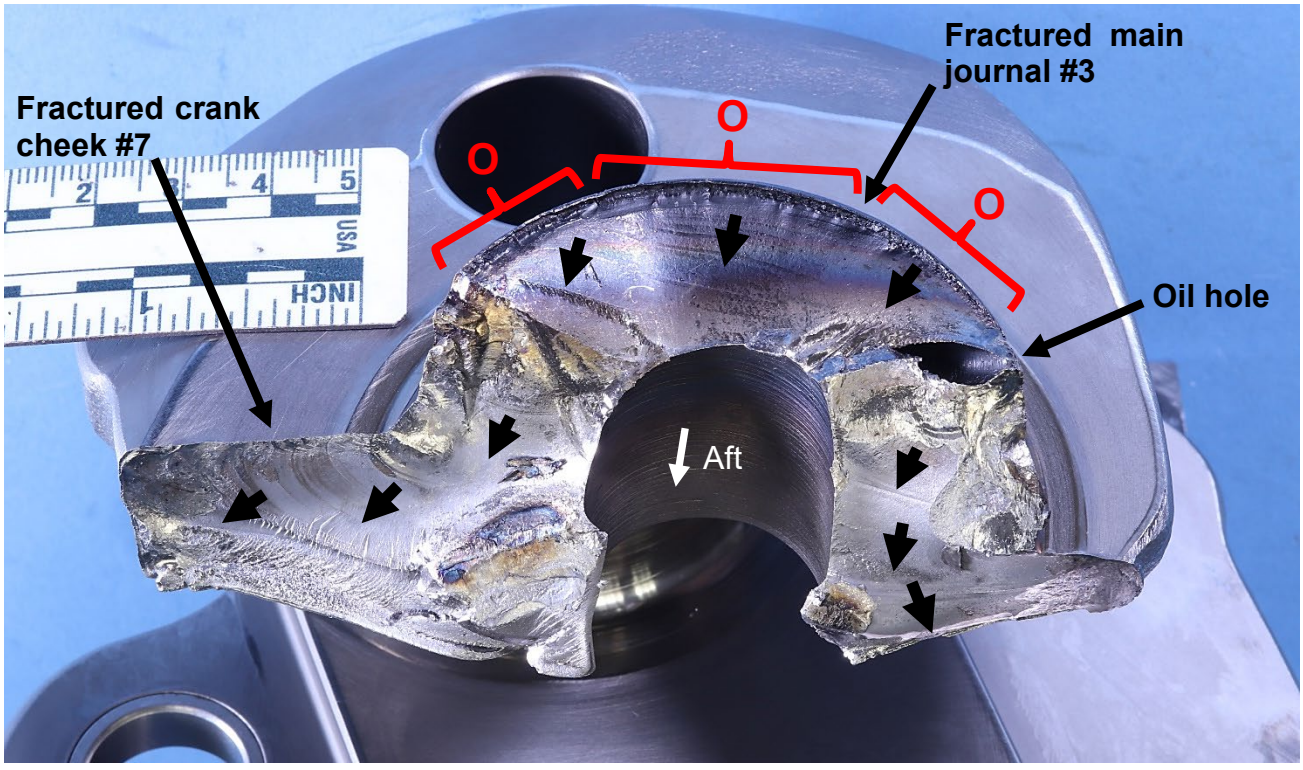

Figure 2. Aft fracture face of main journal #3 showing fatigue crack origin area indicated by brackets “O” and general direction of fatigue crack propagation.

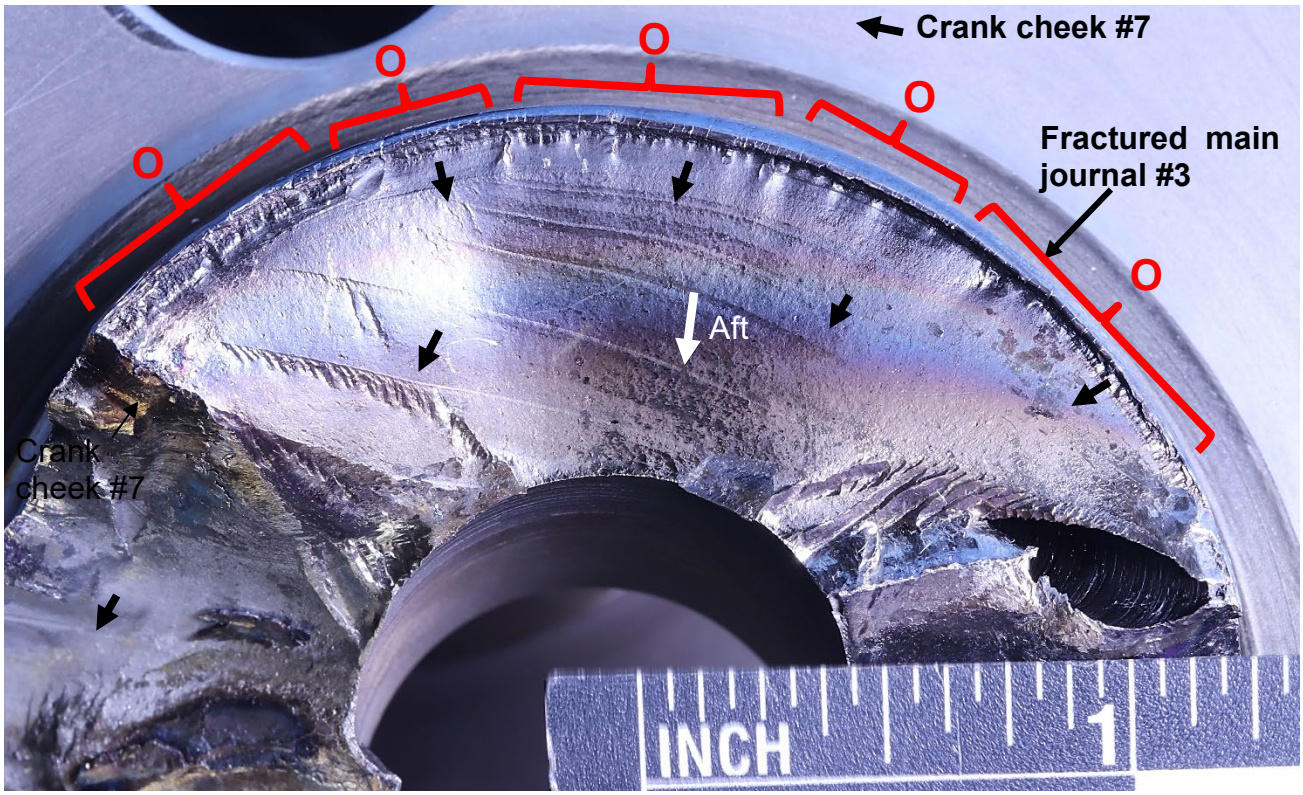

Figure 3. Close-up photograph of the aft fracture face of main journal #3 showing fatigue crack origin area indicated by brackets “O” and general direction of fatigue crack propagation.

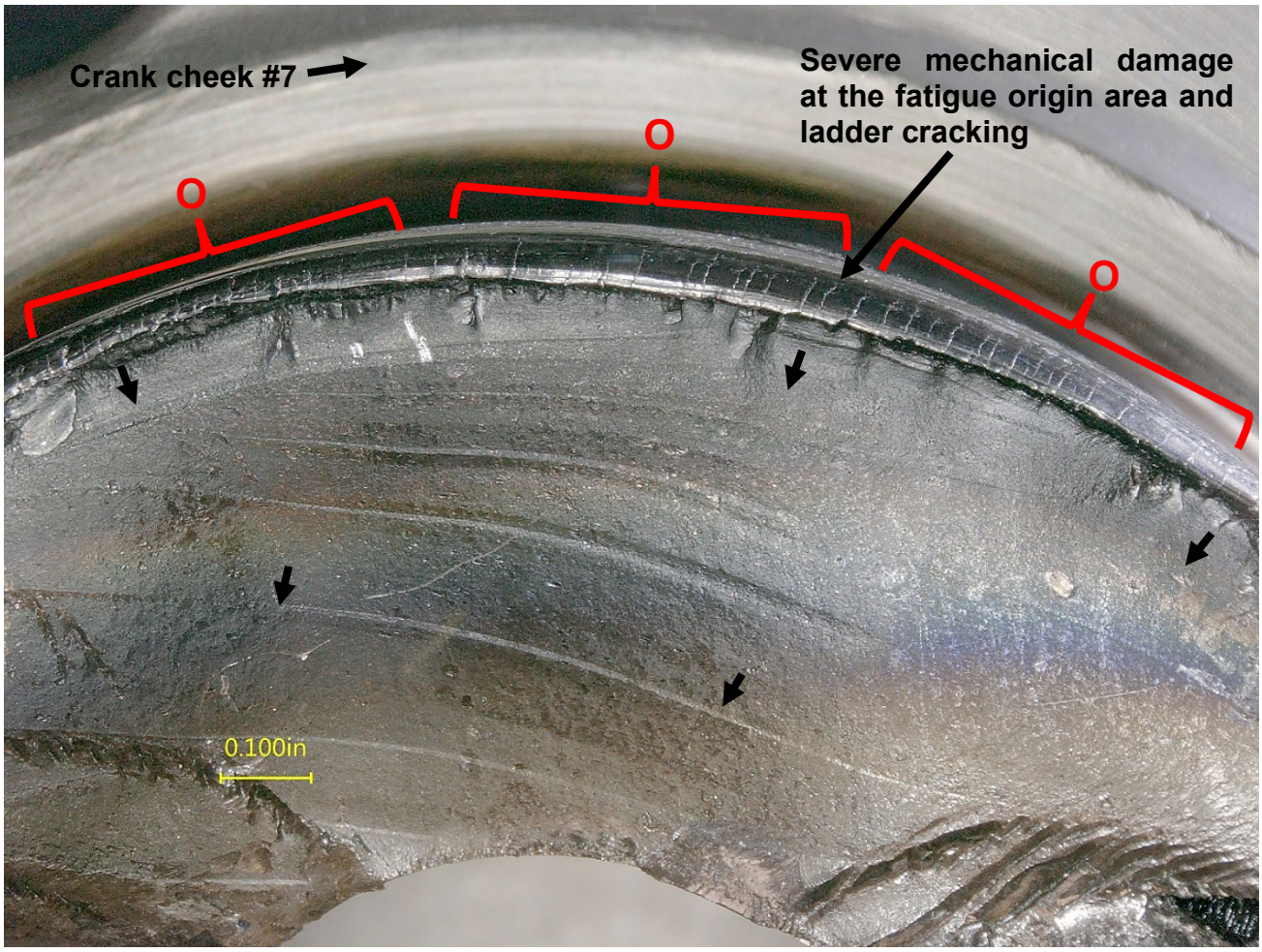

Figure 4. Close-up photograph of the aft fracture face of main journal #3 showing fatigue crack origin area indicated by brackets “O” and general direction of fatigue crack propagation. The origin of the fatigue crack exhibited evidence of severe mechanical damage and multiple ladder cracks.

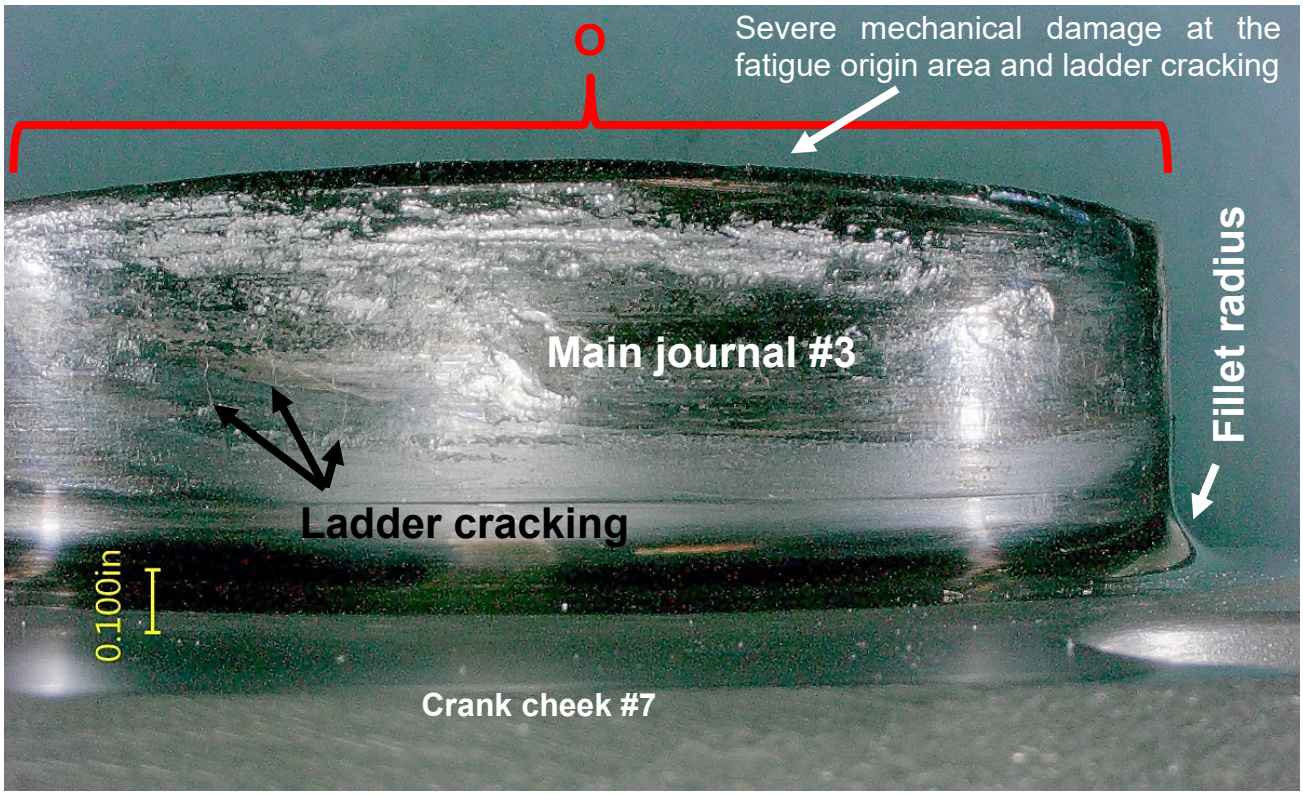

Figure 5. Side view of main journal #3 showing the outer face and severe mechanical damage such as gouges and blue tint.