

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN23LA188

MATERIALS LABORATORY

Factual Report 23-107

December 21, 2023

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A. ACCIDENT INFORMATION

Location: Flower Mound, Texas
Date: May 16, 2023
Vehicle: Cessna 172N, N5550J
Investigator: Jason Aguilera (AS-CEN)

B. COMPONENTS EXAMINED

Rocker arm

C. EXAMINATION PARTICIPANTS

Specialist Adrienne Lamm
 National Transportation Safety Board
 Washington, D.C.

D. DETAILS OF THE EXAMINATION

A rocker arm from a Lycoming O-320 engine installed on the subject aircraft was submitted with the mating pushrod. The pushrod had broken through and was jammed inside the oil squirt hole in the rocker arm. The stuck together mating parts are shown in Figures 1 and 2.

The pushrod was mechanically removed from the rocker arm in the laboratory. The oil squirt hole in the rocker arm after the pushrod had been removed is shown in Figures 3 and 4. A piece adjacent to the hole was pressed inwards in the direction the pushrod drives the rocker arm. A fracture surface was visible on the inner surface of the rocker arm extending circumferentially around the hole.

The rocker arm was cleaned with methanol and examined using stereomicroscopy. Digital microscope images of the fracture surface are shown in Figure 5. The circumferential fracture surface was relatively flat with visible crack arrest marks consistent with fatigue. The crack arrest marks indicated the fatigue emanated from the outboard side of the rocker arm.

There were three radial fractures branching from the circumferential fracture - one nearly aligned with the centerline of the outboard curved geometry of the rocker arm, one diametrically opposite the first, and the last approximately halfway between the other two. Small thumbnail-shaped patterns emanated from the outboard radial crack, as indicated by the white dotted arrows in the bottom image of Figure 5. The macro fracture surface features were consistent with the fatigue cracking progressing circumferentially from that same location, as indicated by the white dotted arrows in the top image of Figure 5. This is consistent with the radial crack occurring prior to the circumferential cracking.

Rocker arms with similar damage have been observed previously by the manufacturer. Lycoming Service Bulletin No. 639 (dated January 17, 2020) details the damage anticipated to the rocker arm oil squirt hole due to contact with the mating pushrod and methodology to inspect for it. Radial cracks are highlighted as warning signs that damage is occurring and that once observed, the rocker arm should be replaced. In the subject rocker arm, the missed and/or unaddressed radial cracks likely led to the circumferential fatigue cracking and subsequent failure of the rocker arm and pushrod assembly.

Submitted by:

Adrienne V. Lamm
Materials Engineer



Figure 1. Overall (bottom) and close-up (top) photos showing the stuck together pushrod and rocker arm. A close-up photo showing the inner surface of the rocker arm looking in the direction of the yellow arrow is shown in Figure 2.

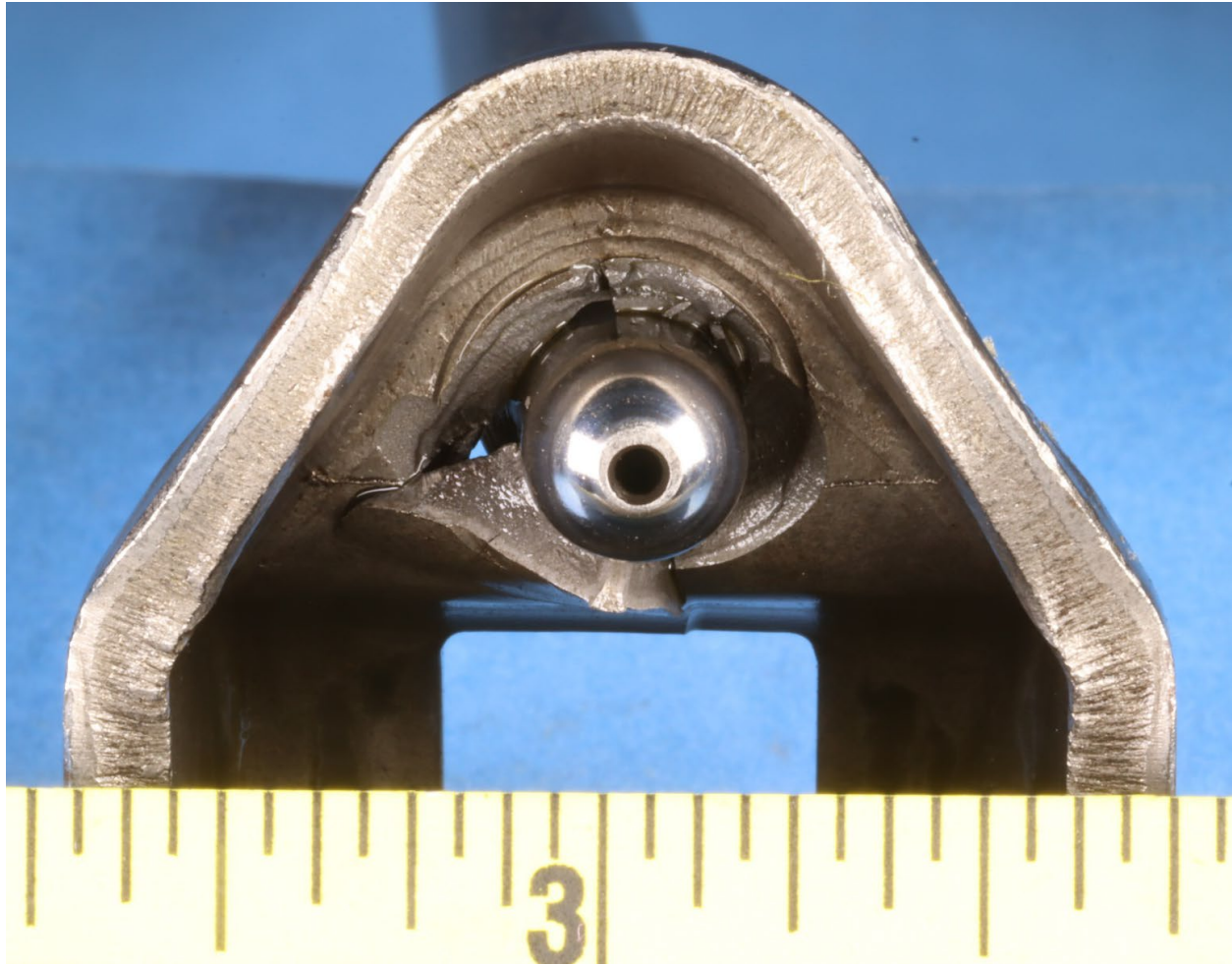


Figure 2. Close-up photo showing the inner surface of the rocker arm looking in the direction of the yellow arrow shown in Figure 1.

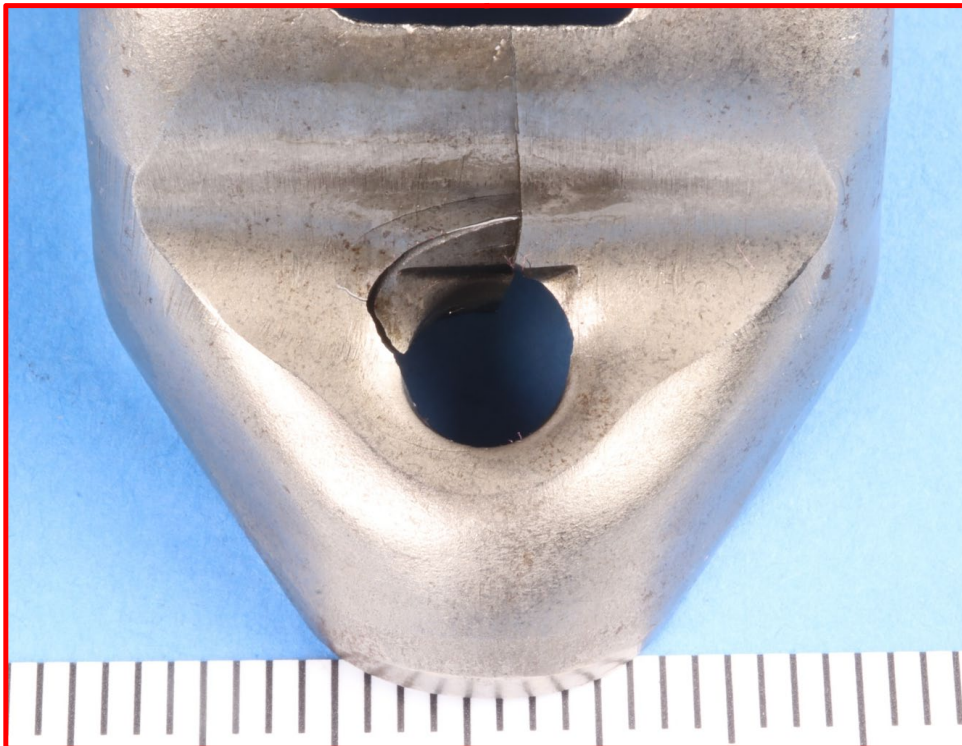
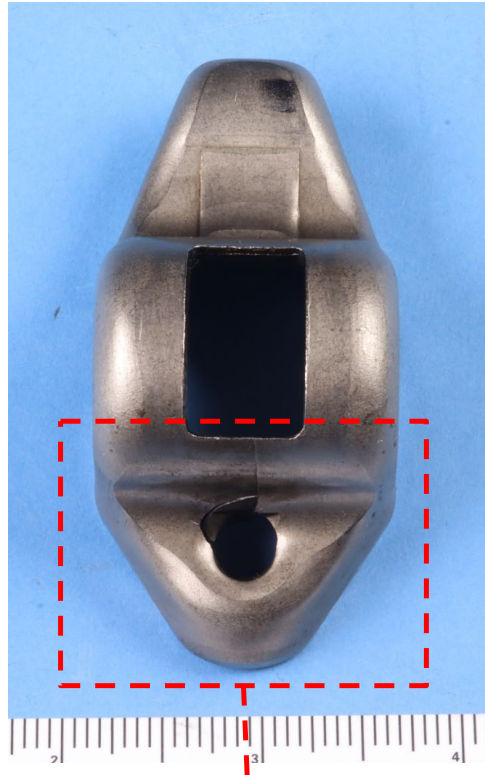


Figure 3. Overall (top) and close-up (bottom) photo showing the outer surface of the rocker arm after the pushrod had been removed.

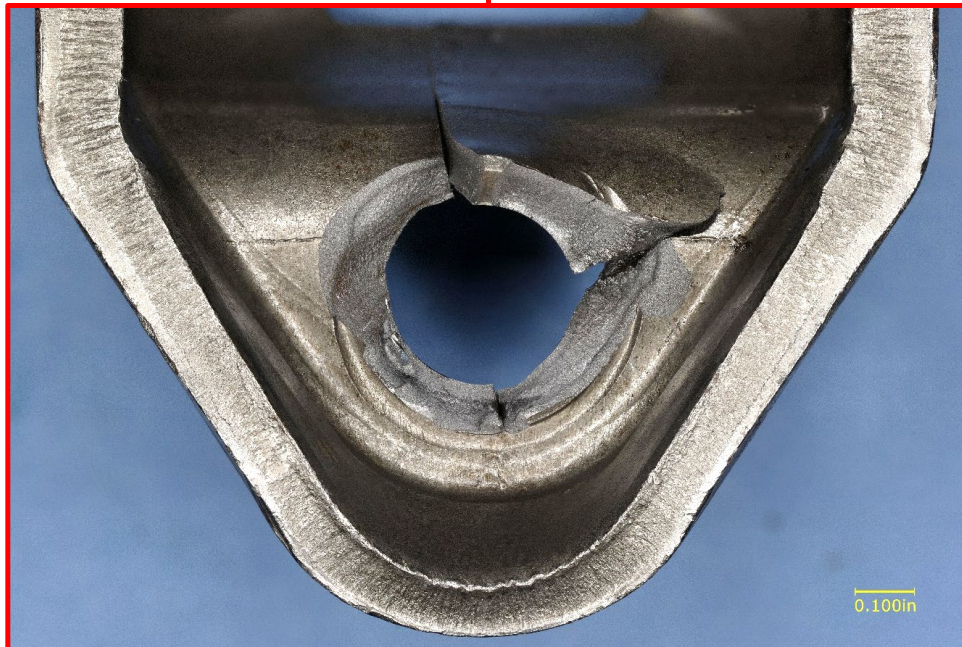
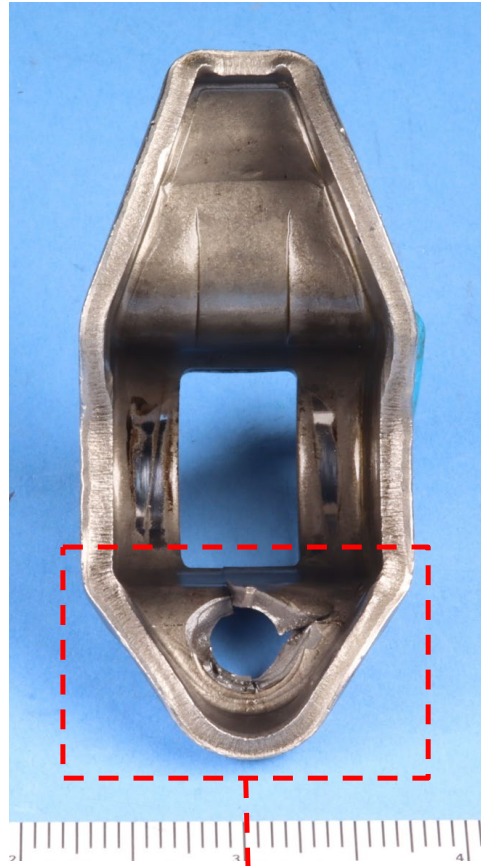


Figure 4. Overall photo (top) and digital microscope image (bottom) showing the inner surface of the rocker arm after the pushrod had been removed.

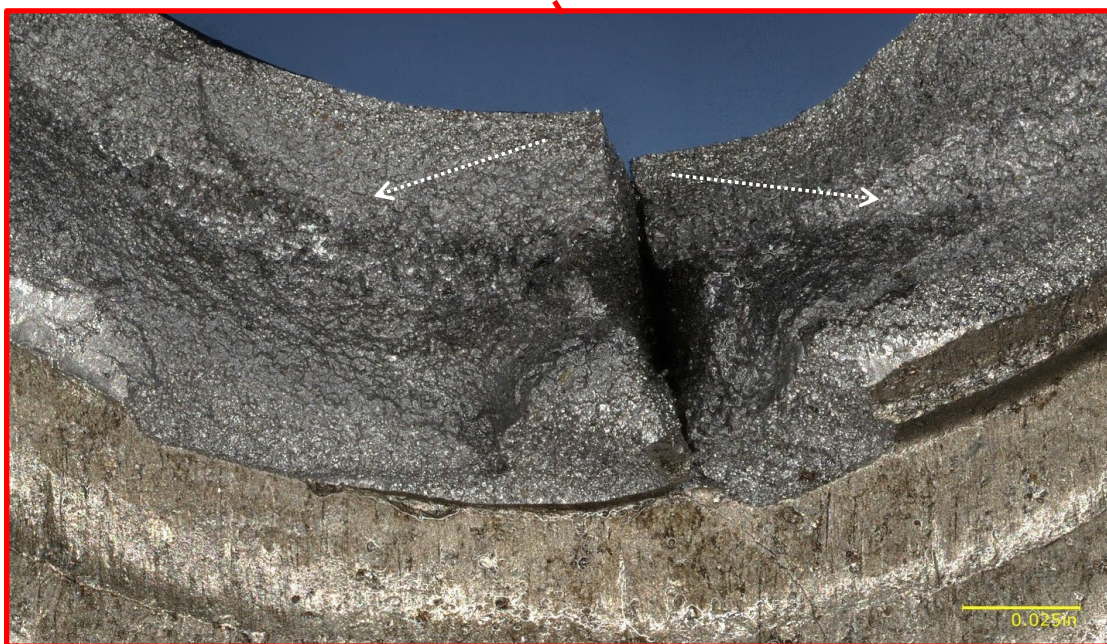
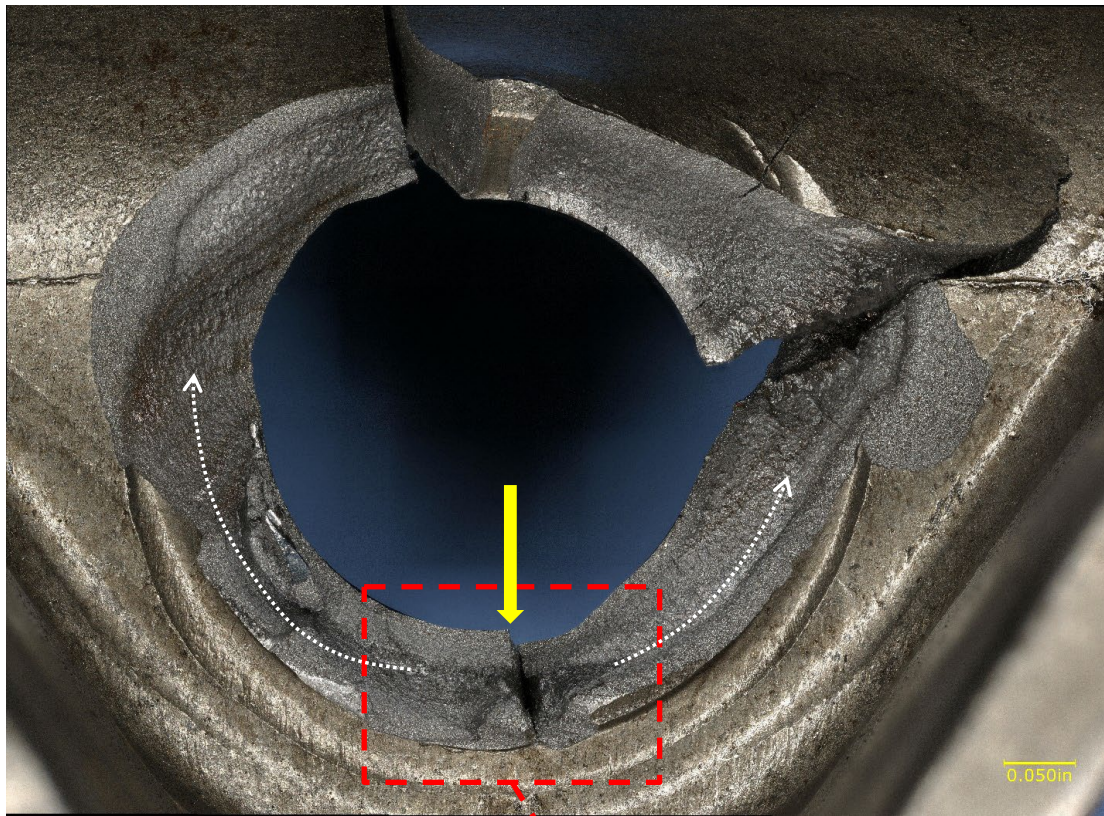


Figure 5. Digital microscope images of the inner surface of the rocker arm with a circumferential fracture surface and radial cracks at the oil squirt hole. The yellow arrow indicates the radial crack on the outboard side of the hole from which the circumferential fatigue cracking emanated, with the direction of fatigue propagation indicated by the white dotted arrows.