

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR23LA215

MATERIALS LABORATORY

Factual Report 24-019

April 4, 2024

(This page intentionally left blank)

A. ACCIDENT INFORMATION

Location: Belfair, Washington
Date: June 4, 2023
Vehicle: Piper J3C-65
Investigator: Daniel Baker

B. COMPONENTS EXAMINED

Crankshaft, fractured crankshaft gear, and attachment bolts for the crankshaft gear from a Continental C-90F engine, serial number 42598-0-8.

C. EXAMINATION PARTICIPANTS

Senior Metallurgist Frank Zakar
 NTSB
 Washington, DC

D. DETAILS OF THE EXAMINATION

Figures 1 through 3 show photographs of the as-received crankshaft parts. The crankshaft was intact and the main and rod journals exhibited a smooth surface with no evidence of tinting (heat damage). The gear located on the aft side of the crankshaft fractured into multiple pieces (7 pieces were submitted). The gear is attached to the crankshaft by four bolts. The four bolts were submitted for examination. Two bolts were intact. The head portion separated from the other two bolts and their thread fragments were lodged in their respective bolt holes.

Binocular microscope examination of the submitted parts revealed the fracture faces of the bolts exhibited fine fracture features and ductile deformation typical of overstress separation in shear mode. Detailed examination of the gear revealed the fractures intersected the root areas of the teeth. The fracture faces of the gear contained mechanical damage. SEM examination was performed on four fracture faces, arbitrarily labelled "1" through "4" in figure 3. Two of the fracture faces, arrowed "1" and "3" in figure 3, contained fatigue striations typical of fatigue cracking that emanated from the root of the gear. The fatigue crack in these two gear fragments extended through the entire width of the gear. Figure 4 shows an SEM image of typical fatigue striations. On fracture face "1" the fatigue crack propagated at least 0.14 inch below the root of the tooth and on fracture face "3" the fatigue crack propagated at least 0.18 inch below the root of the tooth. The terminus of each fatigue crack was not defined because of the severe mechanical damage on the fracture faces. Fracture faces "2" and "4" contained microvoid coalescence features typical of overstress separation. The remaining fracture faces contained severe mechanical damage.

Submitted by:
Frank Zakar
Sr. Metallurgist

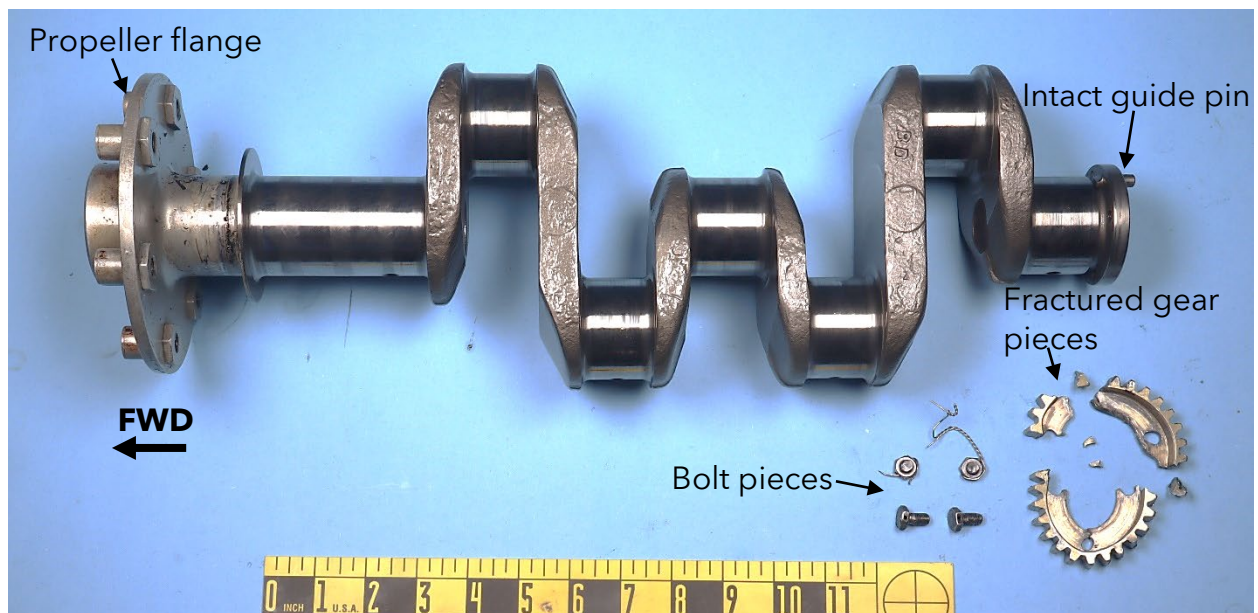


Figure 1. As- received crankshaft (top), fractured crankshaft gear pieces and attachment bolts for the crankshaft gear (bottom right corner).

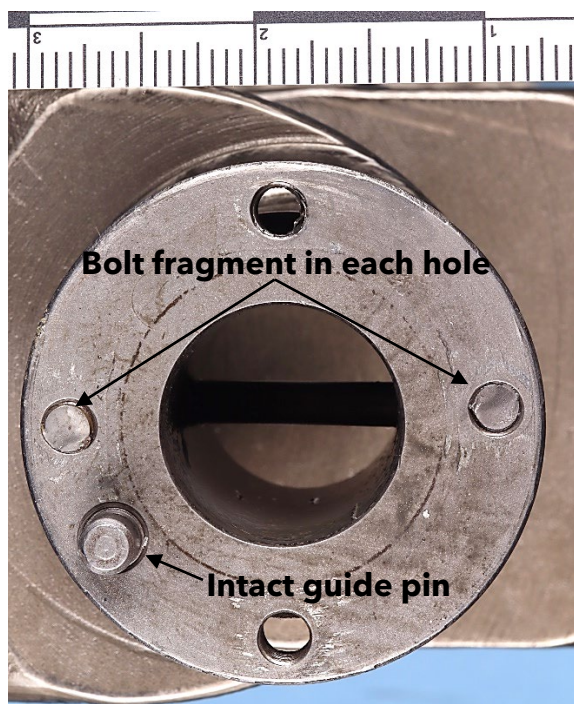


Figure 2. Aft end of the crankshaft showing the intact guide pin and threaded fragment of two bolts that remained lodged in their respective holes.

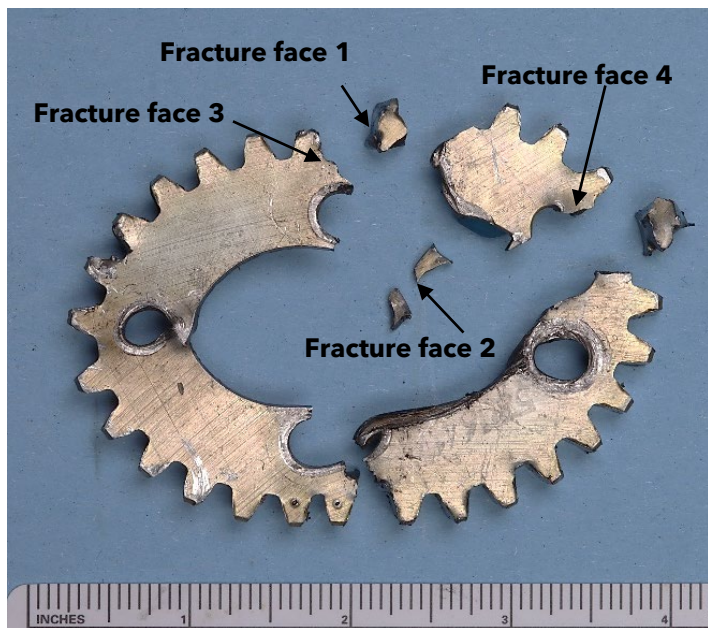


Figure 3. Fractured gear pieces. Fracture faces that were examined by SEM were arbitrarily labelled "1" through "4".

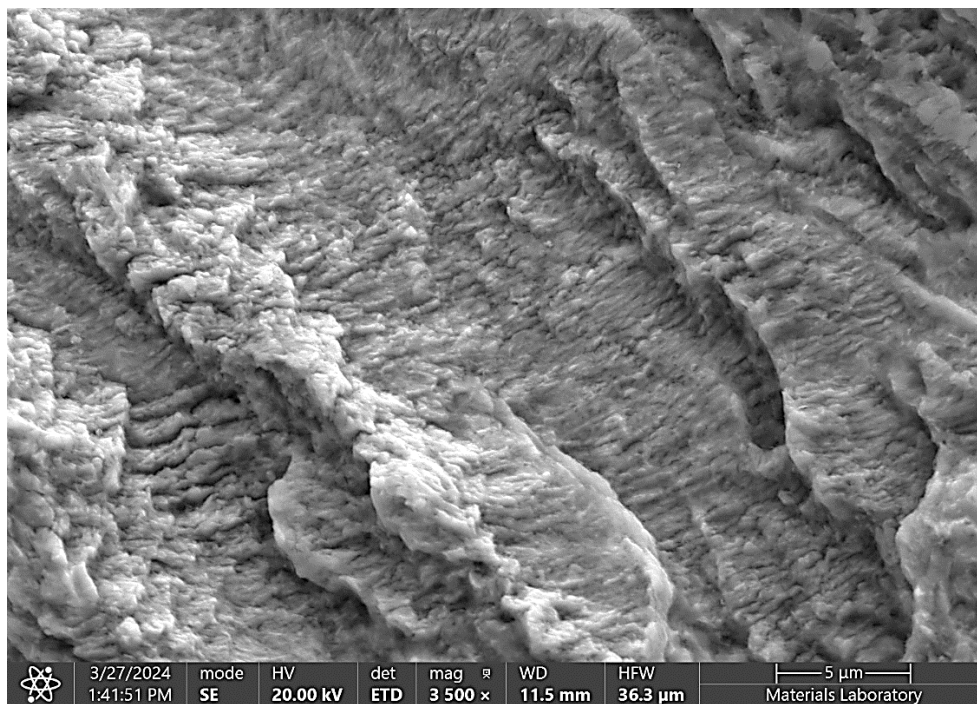


Figure 4. SEM image of typical fatigue striations found on the fractured gear.