

M&P LAB COMPONENT ANALYSIS

Requester: Phillip Grice		Department: Analytical	Date: 4/2/2014	Request #: 515
Component Information:				
Component Part #:	649900	Part Name:	Crankshaft	
Component Serial #:	N01AA316	Aircraft Registration #:	N35952	
Engine Serial #:	821253	Hours in Service:	0	
☒ Photo Documentation ☒ Full Analysis (Destructive) ☐ Other:				
Engine Type: IO - 550 - R				
Details:				
The crankshaft of the engine listed above was presented for analysis under analytical exhibit 1478.				

The crankshaft was in two pieces, fractured between the number 2 crankpin and the #2 main bearing, or on the third cheek, as shown in figure 1. The fracture surface on the aft section was severely damaged, as shown in figure 2. The fracture of the fore section was cut from the rest of the crankshaft for closer analysis. The number 2 main was cut as shown in figure 3. No ladder cracks or post separation cracks were identified using magnetic particle inspection, as shown in figure 4. Figure 5 shows the relatively undamaged fracture surface of the fore section. Beachmarks indicate propagation in fatigue. The ratchet lines indicate multiple initiation points. The fracture propagated in fatigue from the surface, given the lack of any subsurface indication of origin.

The part was sectioned perpendicular to the fracture surface at the initiation area as shown in figure 7. The cross section was mounted and polished for metallography. Figure 8 shows the cross section of the fracture surface. The darker nitride case on the left side is visible below the bearing surface. Figures 9 and 10 show the microstructure of tempered martensite, darkened nitride case, and white layer at the surface. There are small cracks in the white layer that terminate at the nitride case. No inclusions or microstructural anomalies have been identified.

The core hardness of the crankshaft measured 34 HRC and the case hardness 50 HRC as converted from R30N. These hardness readings meet specification.

Conclusion:

- 1) The fracture initiated in multiple areas at the bearing fillet radius and propagated in fatigue.
 - 2) The core harness, microstructure, and surface hardness were in normal condition.
 - 3) There were small cracks in the nitride case, but it is not clear if they are post separation or not.
 - 4) No materials anomalies were observed on the surfaces or cross sections of the part.

Investigator: Mike Byrnes	
☒ Investigation Complete	Date: 4/7/2014
☐ Technical Report Written	
Supervisor:	
☐ Project Complete	Date:

Report Number:

Keywords:





Figure 1. Crankshaft fractured at the third cheek



Figure 2. Aft section fracture surface is obliterated

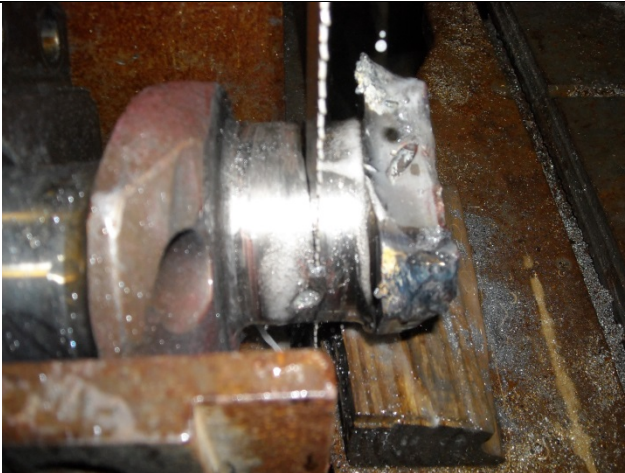


Figure 3. Sectioning #2 main of fore section

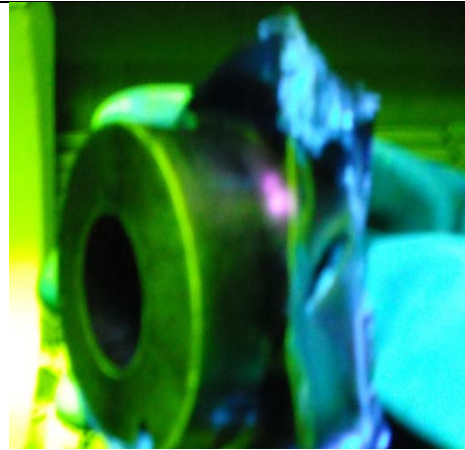


Figure 4. Magnetic particle inspection

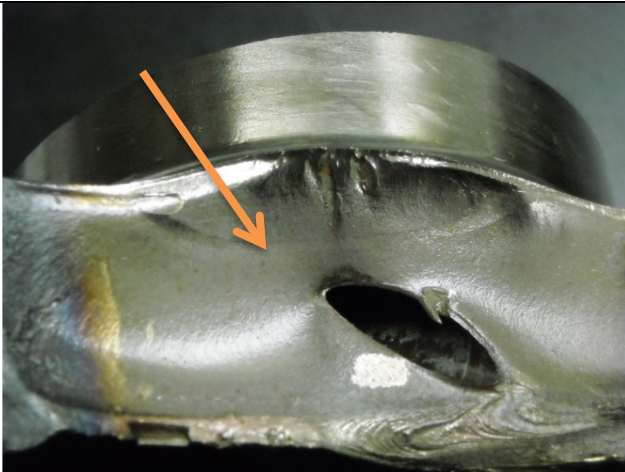


Figure 5. Fracture surface of fore section showing beachmarks

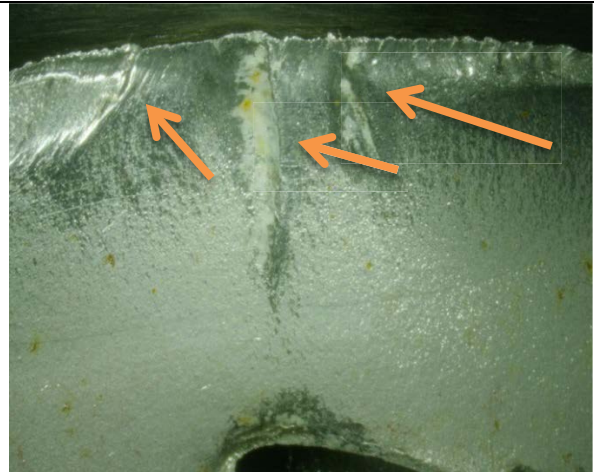


Figure 6. Fracture surface of fore section showing ratchet marks

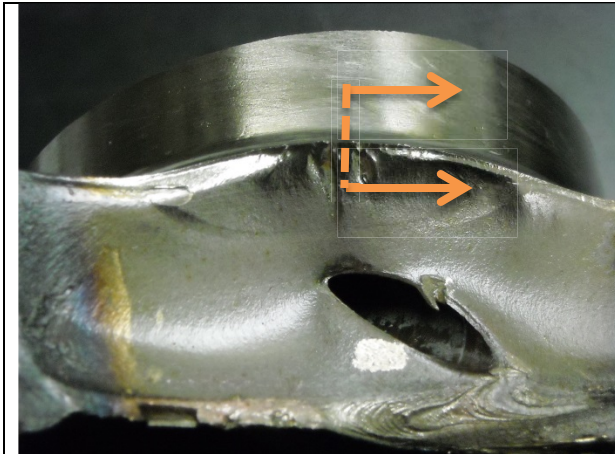


Figure 7. Fracture surface sectioned

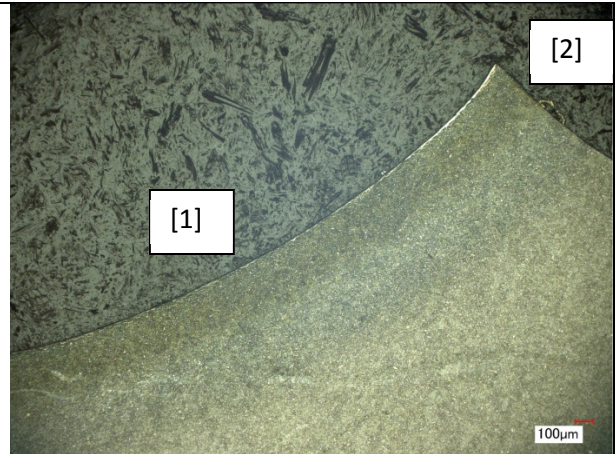


Figure 8. Bearing surface [1] and fracture surface [2] near initiation area.

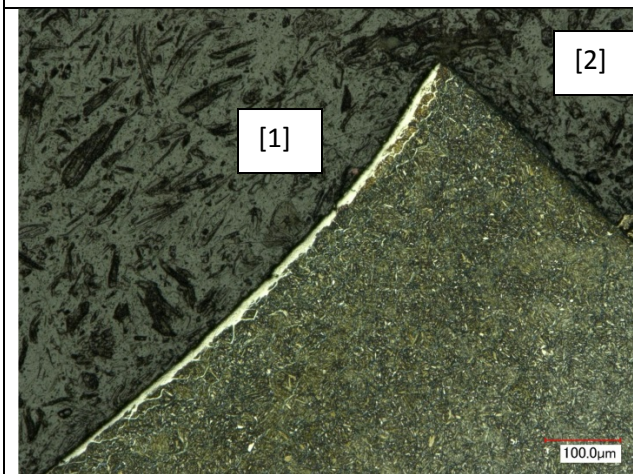


Figure 9. Bearing surface [1] showing nitride white layer and case. Fracture surface has no white layer [2]

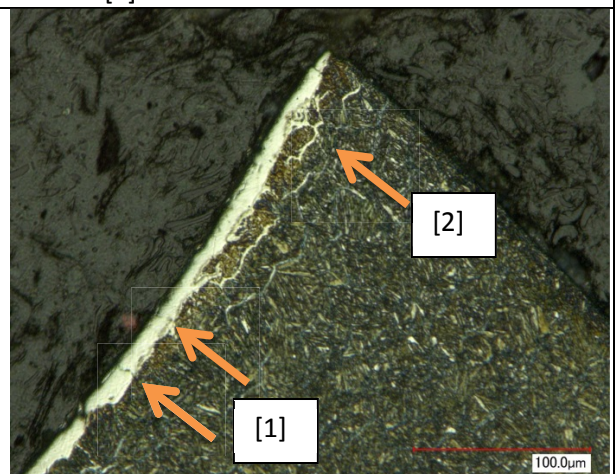


Figure 10. Bearing surface showing cracks [1] in the nitride white layer and white layer below the surface [2]