

ERA22FA086

POWERPLANTS

Group Chair's Factual Report - Attachment # 6

Honeywell Materials Laboratory Report, Engine Serial Number P54133

November 8, 2023

**Pages 1-7 of
ERS-ASYS-PENG-MA-0000924 are
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BACKGROUND

Engine S/N P54133 was the subject of an NTSB investigation of Aircraft N54GP that was involved in an accident near Bedford, New Hampshire. It was reported that engine S/N P54133 had 12,155.5 time since new (TSN) hours, 14,800 cycles, and 2,871.1 time since overhaul (TSO) hours. The time on the shaft was unknown.

PROBLEM STATEMENT

Determine the fracture mode of the submitted coupling shaft (P/N 894119-1) from TPE331 engine S/N P54133.

SUMMARY/CONCLUSIONS

- The separation of the coupling shaft was the result of torsional overload. Overload dimples were observed to be elongated in the counterclockwise direction (forward looking aft (FLA)), which indicated that the aft section separated as a result of torsional loading in the clockwise direction relative to the forward section.
- The base material of the coupling shaft was indicative of the specified H11 tool steel, as determined by energy dispersive X-ray (EDX) analysis.
- No further work was performed per customer request.
- See Findings.

PART NAME:	Coupling Shaft
PART NUMBER:	894119-1
PART S/N:	Not Reported
MODEL/PROGRAM:	TPE331-10UA-511G
MODEL/PROGRAM S/N:	P54133
OPERATING TIME:	12,155.5 hours (TSN)
OPERATING CYCLES:	14,800 cycles
MATERIAL:	H11
MATERIAL SPEC:	AMS6487
SUPPLIER:	Not Reported
SUPPLIER P/N:	Not Reported

Findings

Engine S/N P54133 was the subject of an NTSB investigation of Aircraft N54GP that was involved in an accident near Bedford, New Hampshire.

No additional work was performed on the coupling shaft per customer request.

Macroexamination

The coupling shaft (Lot Number 4557) from TPE331 engine S/N P54133 had separated approximately 0.57" from the aft end (Figure 1). The fracture surface of the separation was oriented normal to the shaft axis and was flat in appearance.

Wear was observed between the shoulder and the separated aft end of the shaft (Figure 2). Contact/wear patterns were observed on both sides of the gear teeth from the aft end of the coupling shaft (green brackets in Figure 3B).

Scanning Electron Microscope (SEM) Examination

The fracture surface of the coupling shaft was examined in the SEM and is shown in Figure 4. Most of the fracture features were obscured by smearing and secondary damage. In areas with less damage, overload dimples elongated in the counterclockwise direction (forward looking aft (FLA)) were observed, which indicated that the aft section of the coupling shaft had separated as a result of torsional loading in the clockwise direction relative to the forward section (aft looking forward (ALF)). The specified direction of rotation of the shaft was counterclockwise FLA.

Chemistry

EDX analysis of the coupling shaft produced a spectrum indicative of the specified H11 tool steel material (Figure 5).

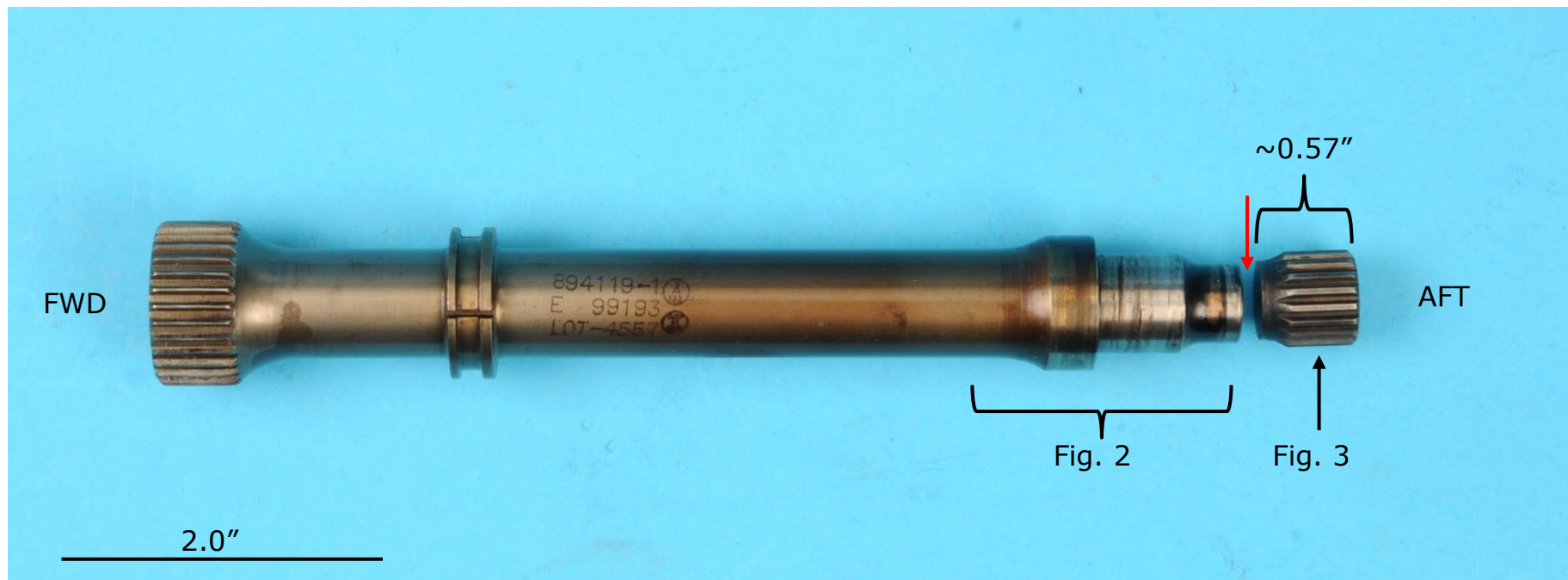


Figure 1.

Overall image showing the as-received condition of the separated coupling shaft (P/N 894119-1, Lot Number 4557) from TPE331-10UA-511G engine S/N P54133. The coupling shaft had separated approximately 0.57" from the aft end (red arrow). Close-up images of the areas identified are shown in Figures 2-3.

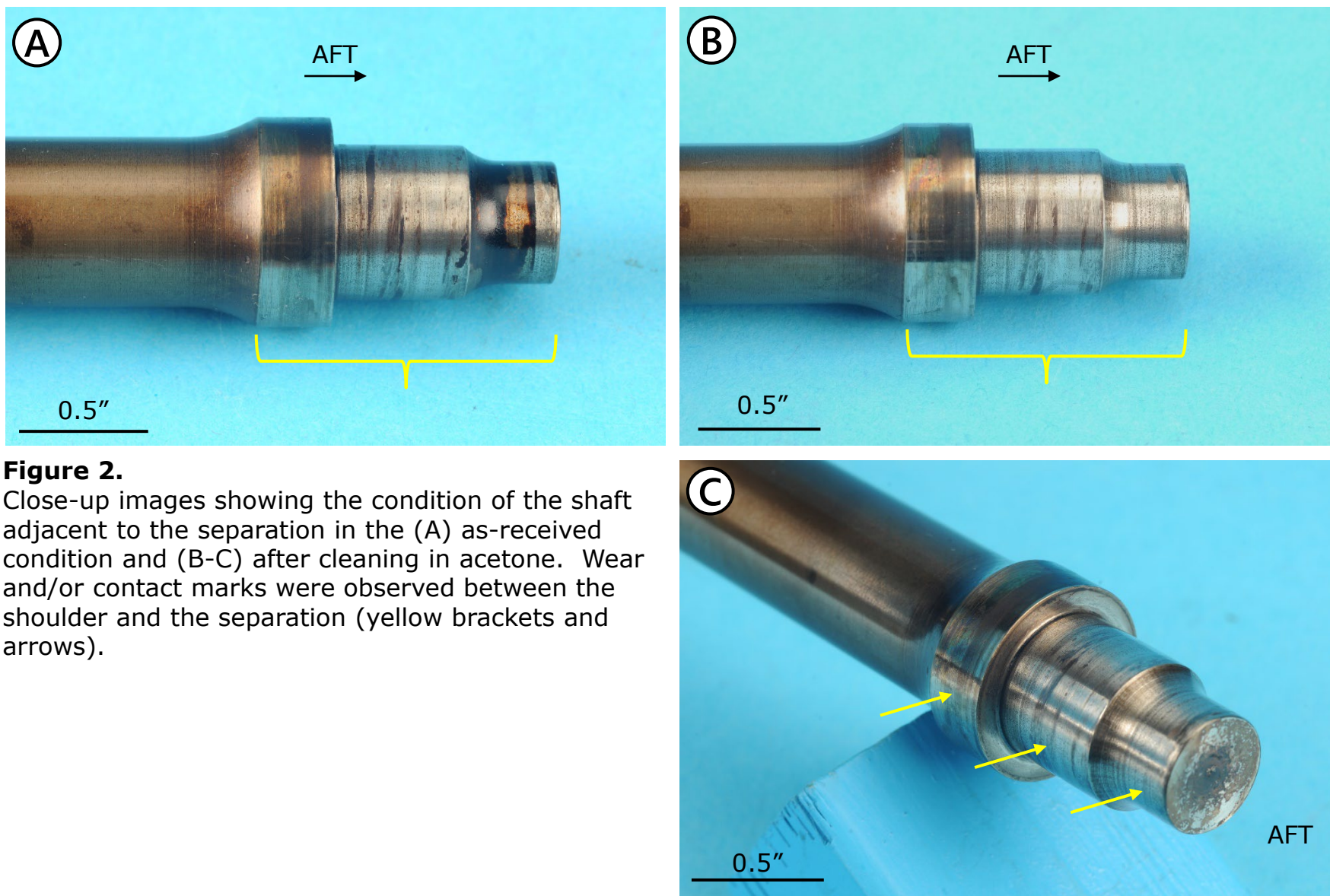


Figure 2.

Close-up images showing the condition of the shaft adjacent to the separation in the (A) as-received condition and (B-C) after cleaning in acetone. Wear and/or contact marks were observed between the shoulder and the separation (yellow brackets and arrows).

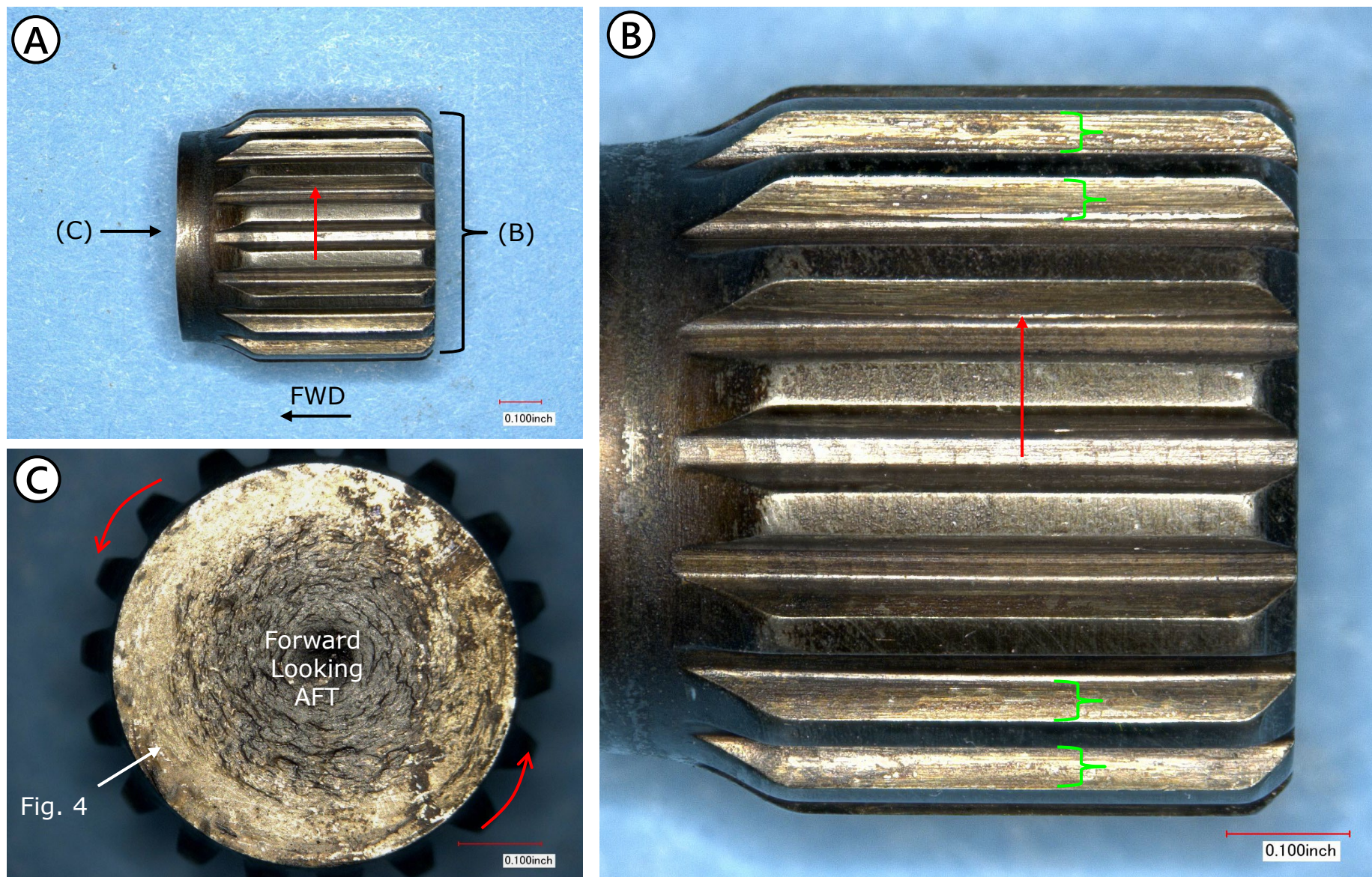


Figure 3.

(A-C) Digital microscope images of the separated coupling shaft (reference Figure 1). The red arrows indicate the specified direction of shaft rotation within the engine (counterclockwise, forward looking aft (FLA)). Wear was observed on both sides of the gear teeth (green brackets in (B)). Scanning electron microscope (SEM) images of the coupling shaft fracture surface are shown in Figure 4.

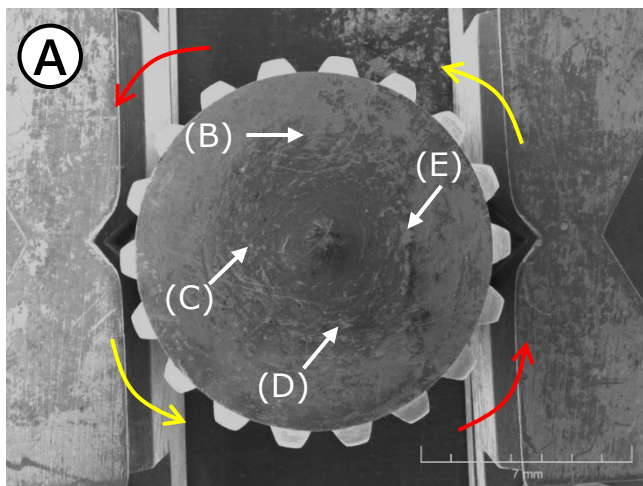
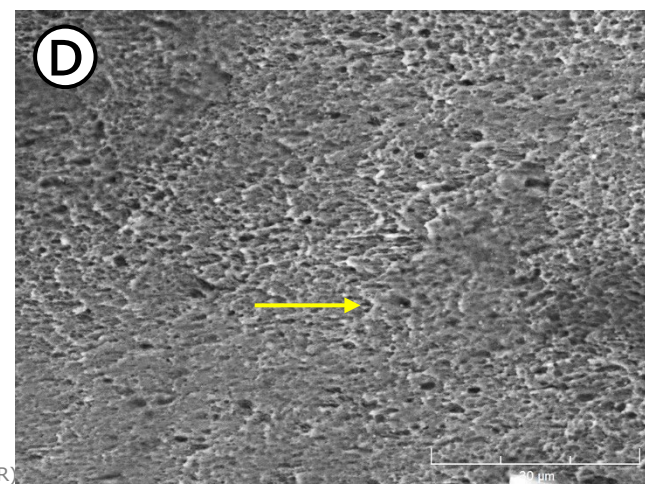
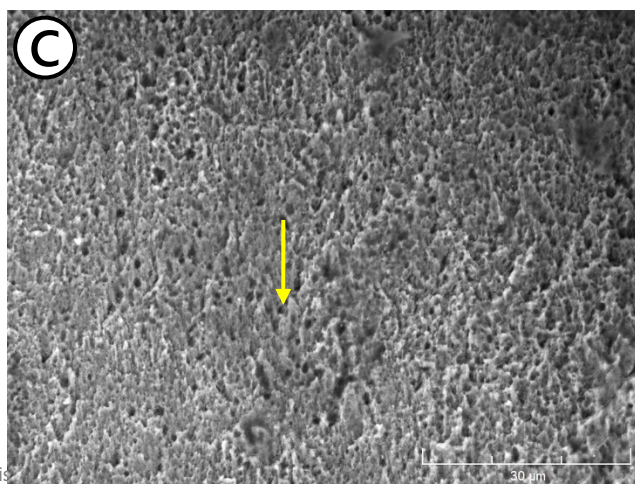
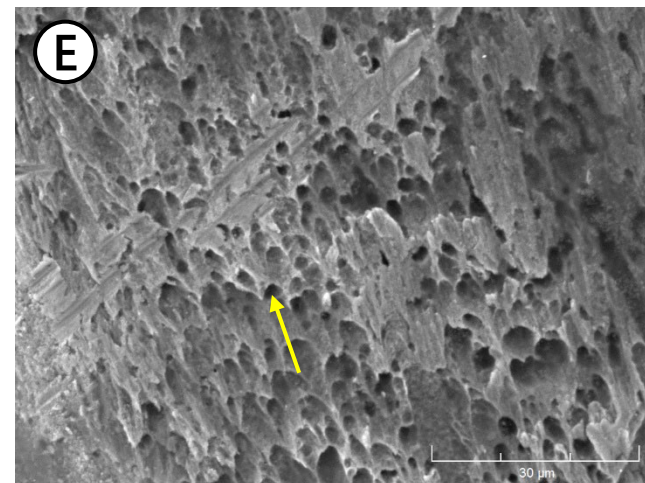
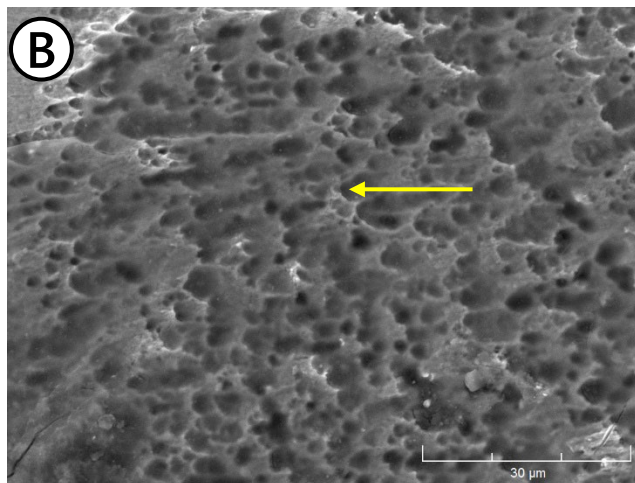


Figure 4.

(A-E) Secondary electron (SE) SEM images showing the fracture surface of the aft section of the separated coupling shaft (reference Figure 3C). Most of the fracture features were obscured by smearing and secondary damage. Fracture features indicative of torsional overload were observed in some locations, as indicated by the elongated dimples in the counterclockwise direction in (B-E). The yellow arrows indicate the direction of the rotation with respect to the mating fracture surface. The red arrows in (A) indicate the specified direction of the shaft rotation within the engine (counterclockwise FLA).



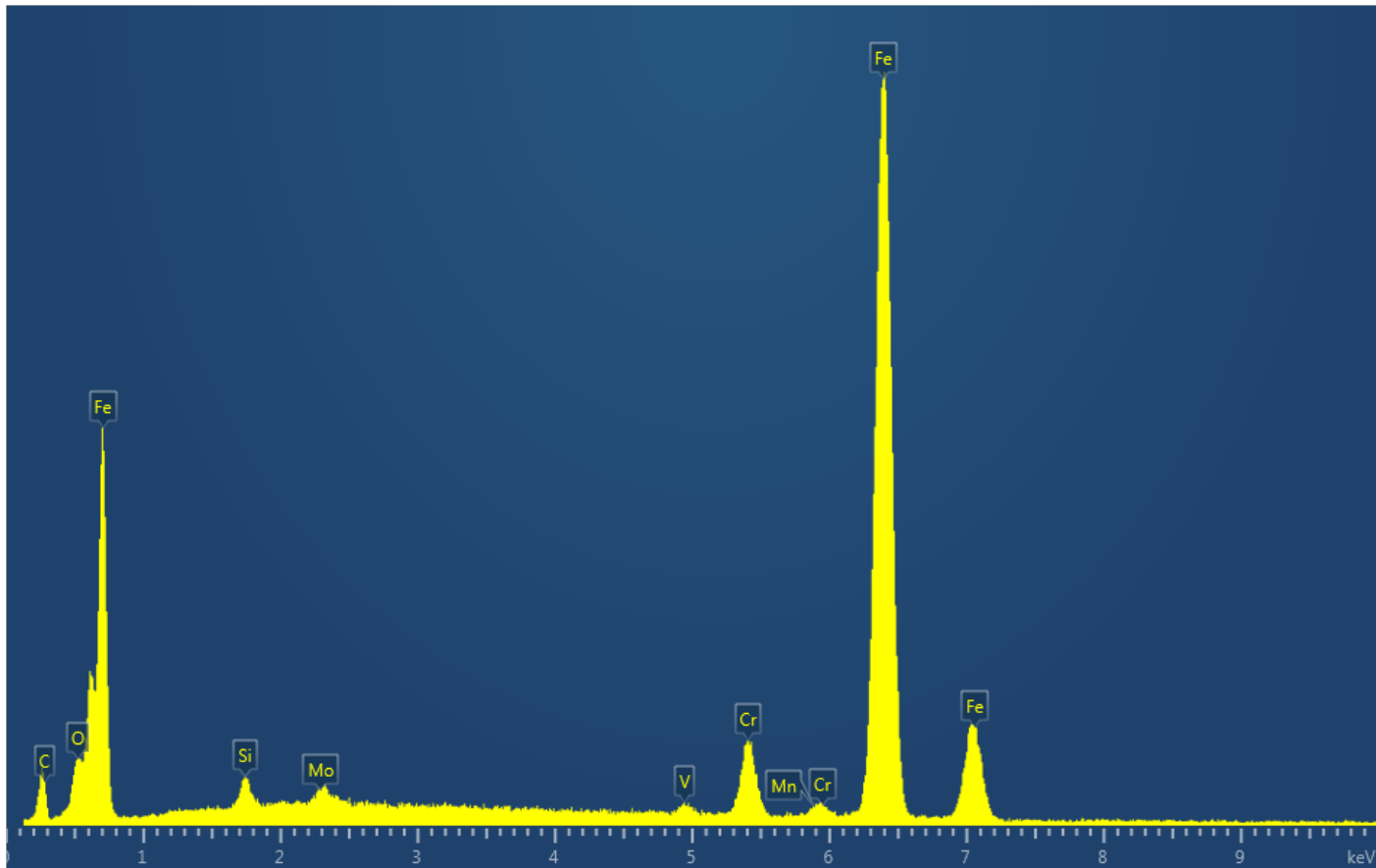


Figure 5.

Representative energy dispersive X-ray (EDX) spectrum produced from analysis of the coupling shaft base material. The spectrum was indicative of the specified H11 material.