

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR24LA067

MATERIALS LABORATORY

Factual Report 24-047

July 26, 2024

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A. ACCIDENT INFORMATION

Location: El Centro, California
Date: December 23, 2023
Vehicle: Bell 206B, N111PM
Investigator: Kristyn Blocher, AS-WPR

B. COMPONENTS EXAMINED

KAflex driveshaft assembly.

C. EXAMINATION PARTICIPANTS

Specialist Matthew R. Fox, Ph.D.
NTSB
Washington, DC

D. DETAILS OF THE EXAMINATION

An overall view of the submitted KAflex driveshaft assembly is shown as received in figure 1. The flex plate at the forward end of the forward flex coupling was fractured where it had been attached to the forward driveshaft fitting as indicated in figure 1. The driveshaft had been cut after the accident as indicated to facilitate removal from the aircraft.

Most of the attachment hardware associated with the forward and aft flex couplings had evidence of yellowish orange torque paint applied at the head side and the nut side of each joint. The aft flex coupling was covered with dark sooty deposits that obscured the visibility of the torque paint throughout the coupling. On close inspection of the aft flex coupling, torque paint was missing, broken, or incomplete on 3 of the 10 bolt heads and all 10 of the nuts. No evidence of relative movement was observed on the aft flex coupling joints in the remaining pieces of torque paint or where relatively cleaner stripes from missing paint were observed in the soot patterns.

On the forward coupling, torque paint was missing, broken, or incomplete on half the bolt heads and 6 of the 10 nuts including the heads and nuts at the forward flex plate. In 4 of the joints where torque paint was missing from one or both sides of the joint, the outer surface of the flex plate showed evidence of circumferential rubbing contact with another object.

Closer views of the forward flex coupling are shown in the lower images in figure 1. At the joint associated with the fracture location, remnants of yellowish orange colored torque paint were observed on the head of the bolt and on the side of the forward flex plate as indicated in the lower left image in figure 1. Additionally,

green torque paint was observed on the nut and adjacent washer, the side of the forward fitting lug, and the edge of the bolt head, also indicated in the lower left image in figure 1. With the green paint on the bolt head aligned with the green paint on the forward fitting lug, the yellowish orange paint remnants on the bolt head and adjacent flex plate would not be aligned if the flex plate was placed in its original installed position. On the opposite side of the coupling, a remnant of yellowish orange paint was observed on the side of the forward flex plate as indicated in the lower right image in figure 1, and paint was absent from the remainder of the joint.

The joint between the forward driveshaft fitting and the forward flex plate was loose, and visible gaps opened as the joint was flexed by hand. Attempts to remove the nut for the loose joint by holding the bolt in place with a hex wrench inserted in the threaded end of the shank while turning the nut were unsuccessful in overcoming the breaking torque on the nut without risk of breaking the hex wrench. Subsequently, the nut was cut using a handheld abrasive cutting tool to facilitate its removal, thereby separating the forward flex plate from the forward driveshaft fitting. The bolts attaching the forward flex plate to the adjacent flex plate were also removed to separate the forward flex plate from the rest of the assembly.

Views of the aft face of the forward flex plate at the fracture location and at the hole opposite the fracture location are shown in figure 2. Both holes were elongated, and surfaces around the hole were dished with thinning through the thickness consistent with wear contact from relative motion between the flex plate and associated bolts and washers. The bolt shanks at both locations were also thinned consistent with contact wear from relative motion between the bolt and the attachment holes. The bolt that was removed from the intact side is shown in the lower left image in figure 2.

Views of the fracture surfaces in the forward flex plate are shown in figure 3. Flat fracture features with curving crack arrest lines were observed, features consistent with fatigue fracture. Fatigue features emanated primarily from origin areas located near the hole bore at the upper and lower surfaces as shown with unlabeled arrows in the middle and lower images in figure 3. Fatigue features emanated across most of the fracture surface on both sides of the hole consistent with high cycle fatigue with relatively low nominal stress levels.

According to Kamatics Service Instruction Number SIN2348 Rev. K, *Installation, Maintenance, and Repair of the KAflex Driveshaft for the Bell 206A and 206B Helicopter*, the driveshaft assembly should be inspected for loose or missing hardware (bolts, nuts, washers), daily (before the first flight of the day). The inspection should include a check of the torque stripes for evidence of slippage. If evidence of loose or missing hardware is found, the driveshaft is to be returned to Kamatics Corporation. The procedures include a warning to not disturb or tighten the flex frame nuts or bolts, and that evidence of turning fasteners by wrench or other means is cause for rejection.

Submitted by:

Matthew R. Fox, Ph.D.
Chief Technical Advisor - Materials

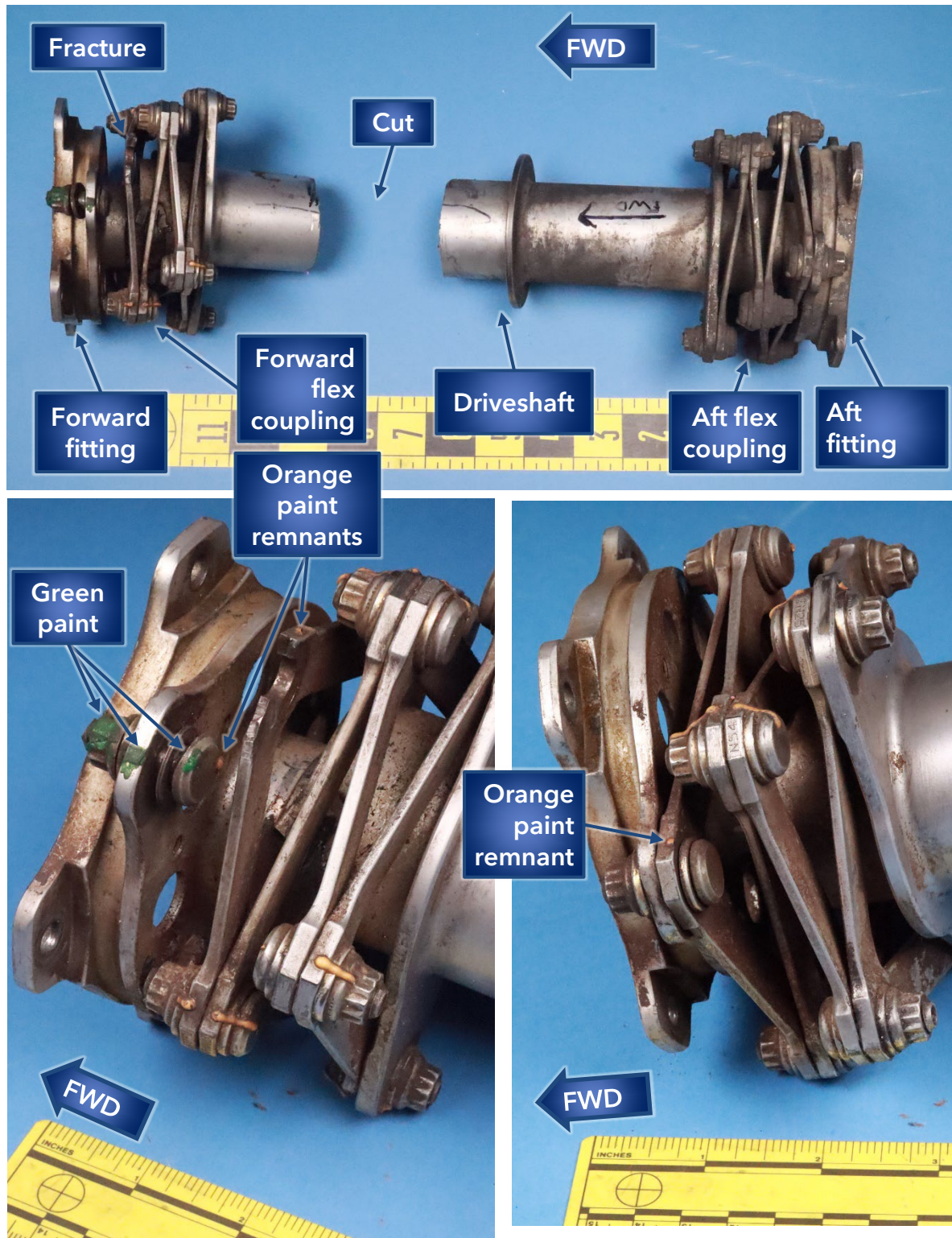


Figure 1. Overall view of the submitted driveshaft assembly (upper image) with closer views of the forward end of the assembly showing the flex plate fracture location (lower left) and the side of the flex coupling opposite from the fracture (lower right).



Figure 2. Aft face of the fractured flex plate after disassembly showing the fracture location (upper image) and the attachment hole on the opposite side of the plate (lower image). The hardware associated with the hole in the lower image is shown at the lower left side of the figure.

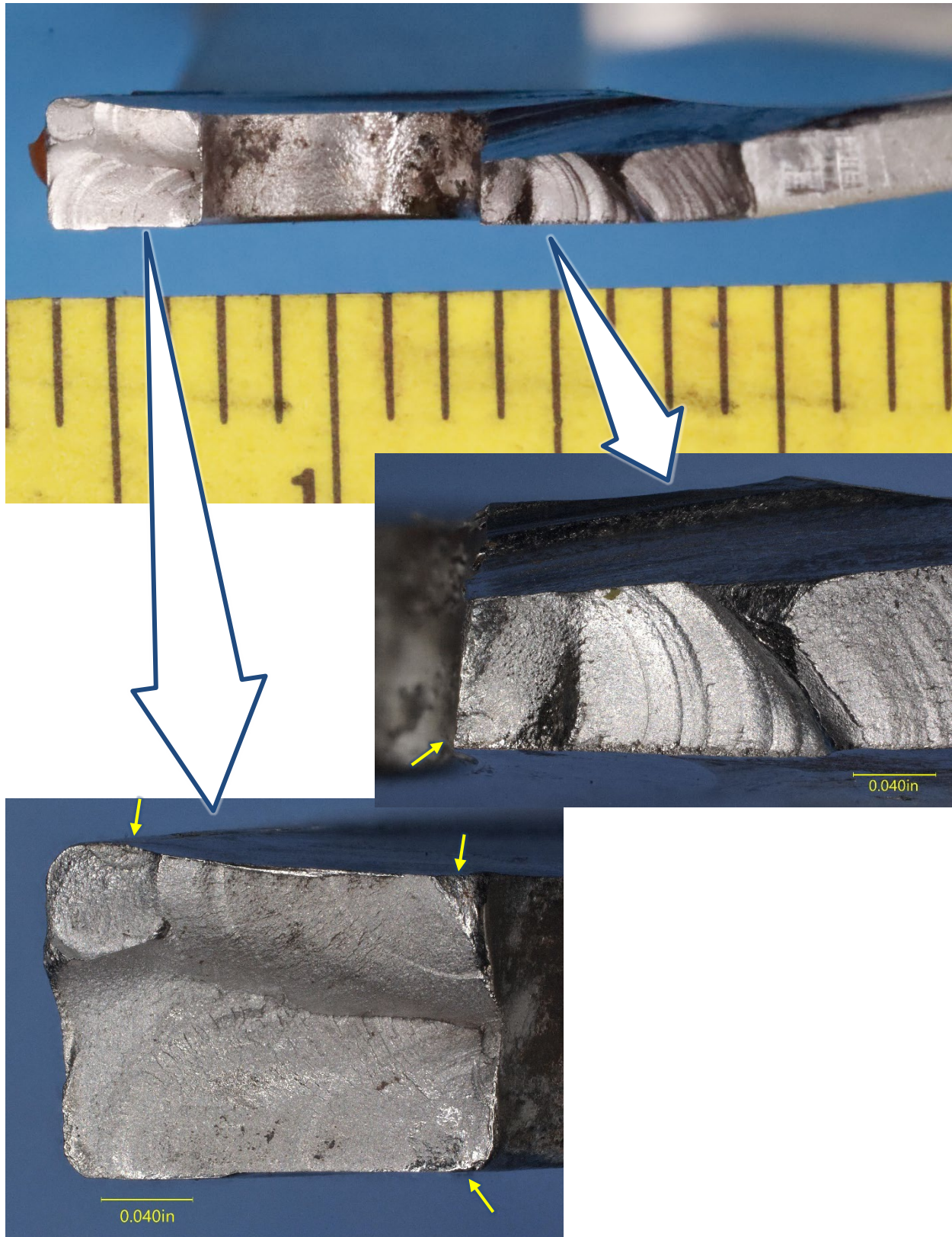


Figure 3. Views of fatigue fracture features on the flex plate fracture surfaces. Unlabeled arrows in the middle and lower images indicate fatigue origin areas.