

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR24LA314

MATERIALS LABORATORY

Factual Report 25-043

July 8, 2025

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A. ACCIDENT INFORMATION

Location: West Sacramento, California
Date: September 19, 2024
Vehicle: Cessna U206G, N6522Z
Investigator: Kristyn Blocher, AS-WPR

B. COMPONENTS EXAMINED

Fuel injector tube assembly for the number 4 cylinder of a Continental IO-550-F21B engine.

C. EXAMINATION PARTICIPANTS

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

D. DETAILS OF THE EXAMINATION

An overall view of the submitted fuel injector tube assembly is shown in figure 1a as received. The assembly had been removed from the number 4 cylinder located on the left side of the Continental IO-550-F21B engine. A black elastomer sleeve was observed near the bend at the outboard end of the tube. The sleeve slid easily along the length of the tube between the bends. The tube was fractured at the inboard end where the tube intersected the shank of the ferrule. A photograph of the engine after it was loaded on a recovery vehicle is shown in figure 2. The fuel injector tube was located above the clamp, and the sleeve was located outboard of the clamp location.

A closer view of the black elastomer sleeve is shown in figure 1(b). Longitudinal manufacturing marks on most of the sleeve surface were missing from the area indicated with a bracket in figure 1(b), and rounded accumulations of material were observed at the edges, features consistent with wear. The sleeve wall thickness in the worn area was up to 0.013 inch less than the adjacent locations inboard and outboard of the worn area. Pairs of circumferential marks were observed at each end of the worn area. The total extent of the worn area between the outer marks was 0.559 inch long. The inner marks were 0.495 inch apart.

The tube was fractured where it intersected the shank of the ferrule that was brazed onto the inboard end of the tube as shown in figure 1(c and d). The outboard end of the ferrule shank was cut at an angle such that the upper side of the shank was longer than the lower side, and the fracture generally followed the profile of the shank end face. Flat fracture features with curving crack arrest marks consistent with fatigue were observed extending around the circumference of the tube, and the

crack fronts overlapped at the aft side of the tube as indicated in figure 1(c). The portion of the crack extending counterclockwise in the view shown in figure 1(d) then turned toward the portion extending clockwise, forming a step on the fracture where the cracks intersected.

The fatigue origin area was located at the lower forward quadrant of the tube's outer diameter as indicated with brackets in figure 1 (c and d). Multiple ratchet marks were observed, consistent with multiple origins within the bracketed area.¹

Submitted by:

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

¹ A ratchet mark is a small step in the fracture surface formed when two adjacent fatigue cracks originate on slightly offset planes.

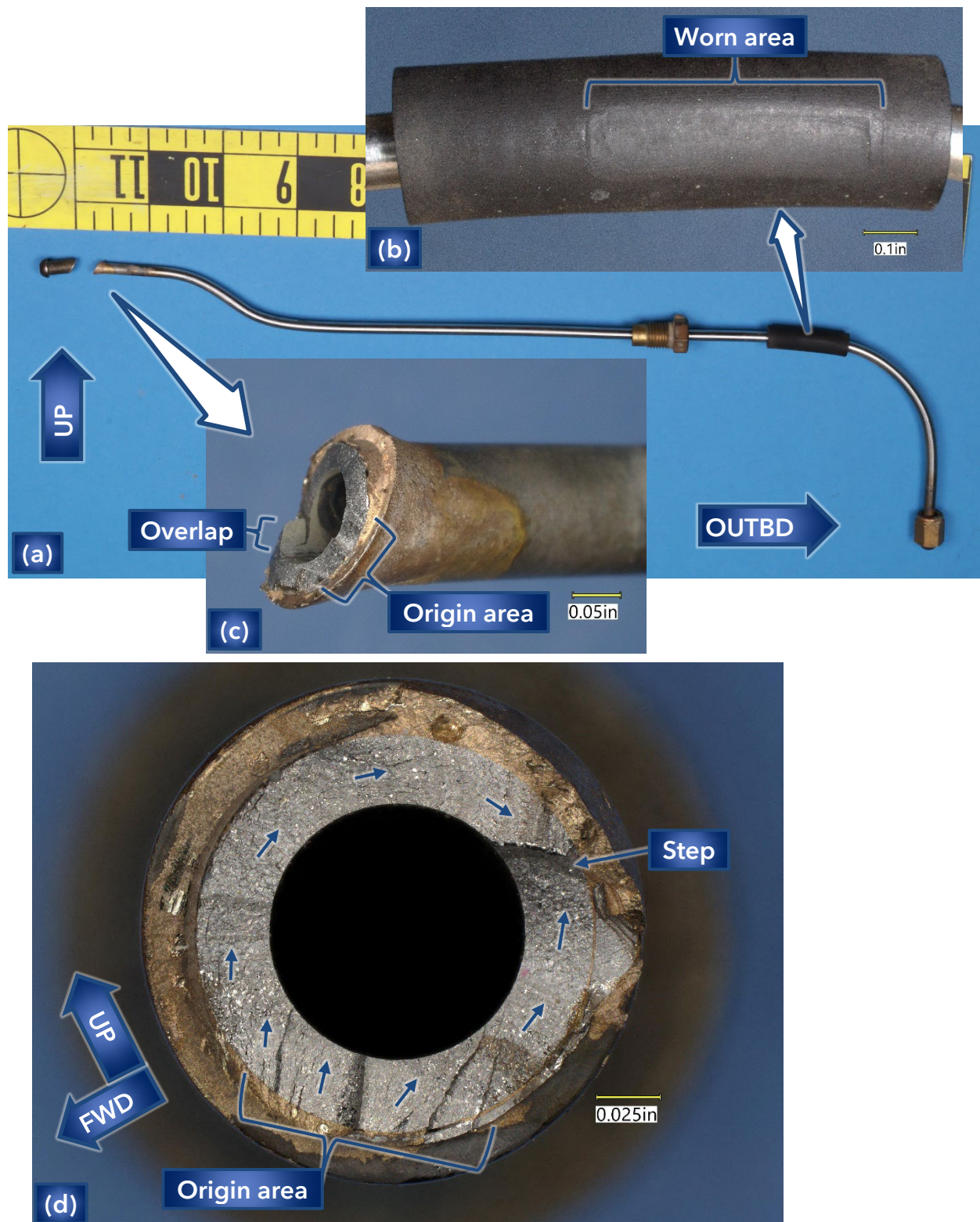


Figure 1. (a) Overall view of the forward side of the submitted fuel injector tube assembly as received. (b) Closer view of wear on the elastomer bushing. (c) Oblique view of the tube side of the fracture. (d) Ferrule side of the fracture surface. Unlabeled arrows indicate local fatigue propagation directions.



Figure 2. Photograph of the engine after it was loaded onto a recovery vehicle. A green arrow points to the clamp location for the number 4 fuel injector tube. (Courtesy of the wreckage recovery team)