

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR23LA340

MATERIALS LABORATORY

Factual Report 23-092

November 17, 2023

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A. ACCIDENT INFORMATION

Location: Bullhead City, Arizona
Date: September 5, 2023
Vehicle: Rutan Long EZ, N58JB
Investigator: Zoë Keliher, AS-WPR

B. COMPONENTS EXAMINED

Nose landing gear actuator ball screw assembly.

C. EXAMINATION PARTICIPANTS

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

D. DETAILS OF THE EXAMINATION

An overall view of the submitted components is shown in figure 1. The ball screw was bent and fractured in two locations. The forward end of the housing for the extension tube was fractured and splayed outward. No manufacturer or model number markings were observed on the submitted assembly pieces.

The ball screw was bent near the bearing at the aft end of the screw and in the opposite direction at the fracture locations near the forward end of the screw. In the upper image in figure 2, the original axis of the ball screw is indicated with a straight dashed line aligned to the aft end of the shaft, which highlights the deformation of the ball screw which formed an elongated "S" shape. Fracture features associated with the ball screw fractures are shown in the lower images in figure 2. The fractures showed matte gray features on slant angles around the circumference with a middle portion that was rougher and more reflective. Overall, the deformation and fracture features associated with the ball screw were consistent with buckling deformation and overstress fracture. No evidence of a preexisting crack was observed.

The forward end of the housing was fractured and splayed outward as shown in figure 3. The housing fracture surfaces were on slant angles consistent with ductile overstress fracture. Contact marks were also observed on the interior surfaces of the tube. The overall deformation and contact patterns were consistent with off-axis contact between the housing and the extension tube. In the lower image in figure 3, the extension tube is shown resting against the deformed surfaces of the housing, illustrating relative axial displacements associated with the observed deformation patterns and contact marks.

The total length of the exposed ball screw pieces shown in figure 2 were measured with calipers, and the length of the screw portion of the assembly from the bearing face at the aft end of the screw to the fracture surface at the aft end of the extension tube was approximately 7.42 inches. Additionally, the overall length of the ball screw assembly between the attachment hole centers at the time of fracture was measured by adding (1) the distance from the aft attachment hole center to the aft ball screw fracture, (2) the distance between the two ball screw fractures, and (3) the distance from the aft end of the extension tube to the forward attachment hole center. The total length obtained by adding the three measurements was 17.41 inches. For comparison, an engineering drawing for the EZ-Noselift NL1-12 for installation on the Long EZ aircraft measures 16.711 inches between the forward and aft attachment hole centers when fully extended.

Submitted by:

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



Figure 1. Overall view of the submitted ball screw assembly.

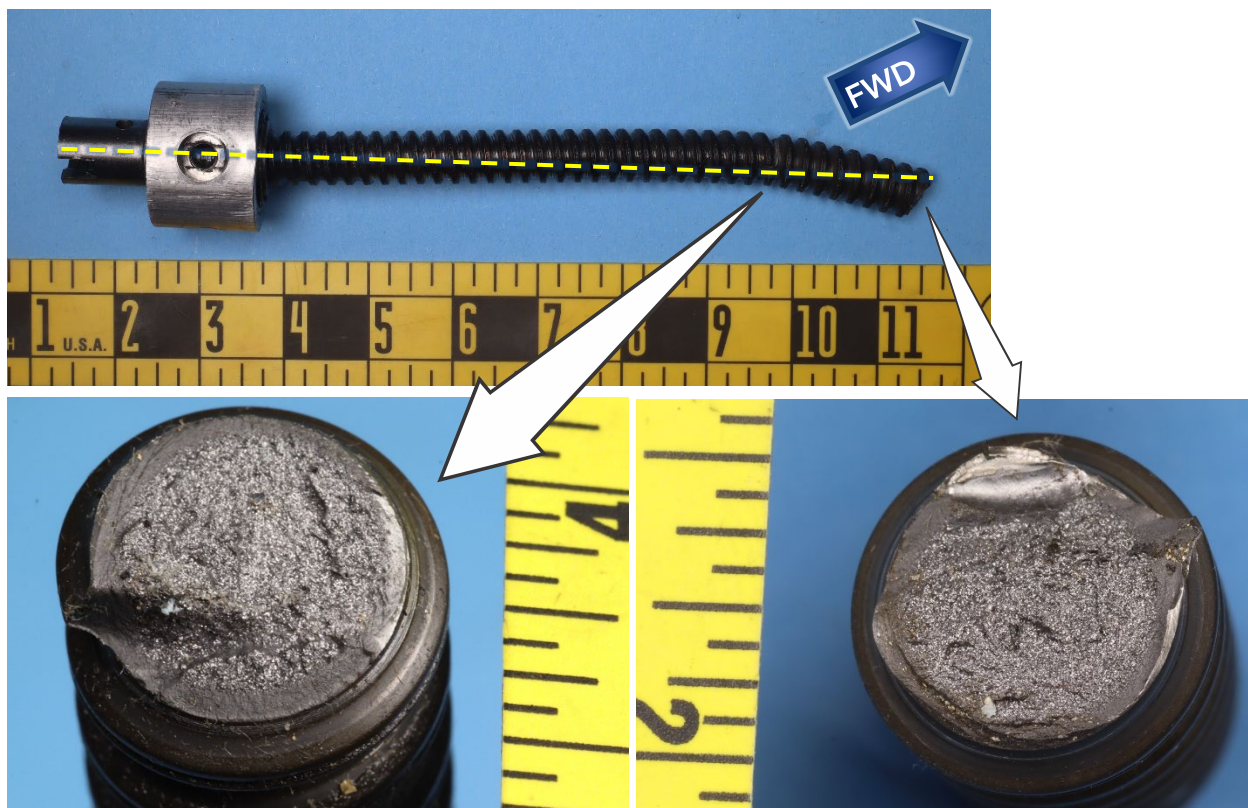


Figure 2. The upper image shows the ball screw with mating fracture features in close proximity where a dashed line indicates the original axis. The lower images show the aft side of the fracture at each of the two fracture locations.



Figure 3. Forward end of the housing showing contact marks and deformation patterns (upper image). In the lower image, the extension tube is shown placed against the deformed surfaces at the forward end of the housing.