NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

August 14, 2014

MATERIALS LABORATORY FACTUAL REPORT Report No. 14-053

A. ACCIDENT INFORMATION

Place	:	Duluth, Minnesota
Date	:	June 7, 2014
Vehicle	:	Lancair IV, N86NW
NTSB No.	:	CEN14FA278
Investigator	:	Jim Silliman, ASI-CEN

B. COMPONENTS EXAMINED

Rudder bellcrank with a section of the right push-pull rod attached;
Connected sections of the vertical stabilizer bulkhead and rudder.

C. DETAILS OF THE EXAMINATION

The rudder bellcrank and rudder/stabilizer bulkhead assemblies were received by the Lab as shown in figure 1. The rudder bellcrank was comprised of a left arm and a right arm. On each arm, there were attachment points for a control cable input and a push-pull rod output. There were two holes in the vertical stabilizer bulkhead, as shown in figures 2 and 3a, that allowed the push-pull rods (hereafter referred to as rods) to connect to the forward rudder spar via an attachment fitting (see figure 3b). The right and left rods were fractured. Pieces of the right and left rods were attached to the rudder and a piece of the right rod was attached to the bellcrank. By contrast, there was no corresponding piece of the left rod attached to the bellcrank. A closer examination of the right rod fracture surfaces revealed that they did not match, indicating that the right rod had fractured in two or more locations and an intermediate section had been separated and was not recovered. An examination of the bellcrank revealed a deformation mark on the forward portion of the right arm in the vicinity of the bellcrank stop as indicated in figure 4.

The left and right rod fracture surfaces were visually examined using a stereomicroscope. The fracture surface on the left rod piece attached to the rudder consisted of inclined slant fractures, and no apparent out-of-plane deformation, consistent with a tensile overstress fracture. The right rod had collapsed near each fracture. The initially circular tube cross sections had deformed by elongating in one direction and collapsing in the other direction. The rod end at the forward end of the right rod (attached to the bellcrank via a rod end bearing) was bent. The features were consistent with overload by compressive buckling.

The vertical stabilizer and rudder sections were separated by disassembling the spherical bearing connection and the rod ends were examined. As shown in figure 3b, the jamb nuts were seated against the female-threaded rod end bearings and the rod ends were fully inserted into the jamb nuts. An attempt was made to back the rod ends out of their respective end connections by hand, but neither rod end could be backed out. By comparison, the rod end at the forward end of the right rod (attached to the bellcrank) could be backed out by hand.

The female threads in the rod end bearings attached to the bellcrank were examined with a stereomicroscope. For the left rod end bearing, there were two isolated spots along the outermost thread where the thread was deformed, as indicated by the boxes in figure 5. Similarly for the right rod end bearing, there were two isolated spots along the outermost thread where the thread was deformed, as indicated by the boxes in figure 6.

Donald Kramer, Ph.D.
Sr. Materials Engineer

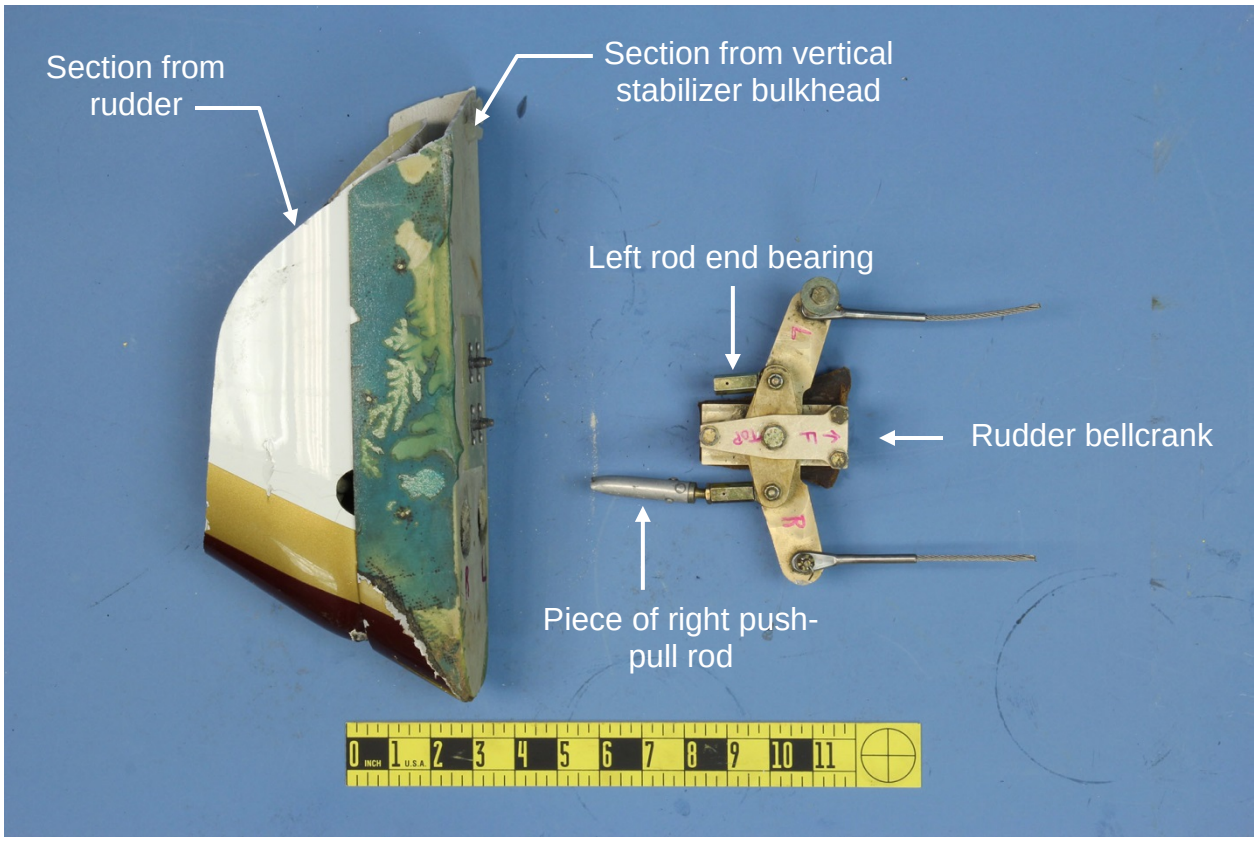

Figure 1: The rudder bellcrank with attached piece of right push-pull rod and section of vertical stabilizer bulkhead/rudder, as-received.

Figure 2: View of the vertical stabilizer bulkhead section and push-pull rods viewed looking in the aft direction.

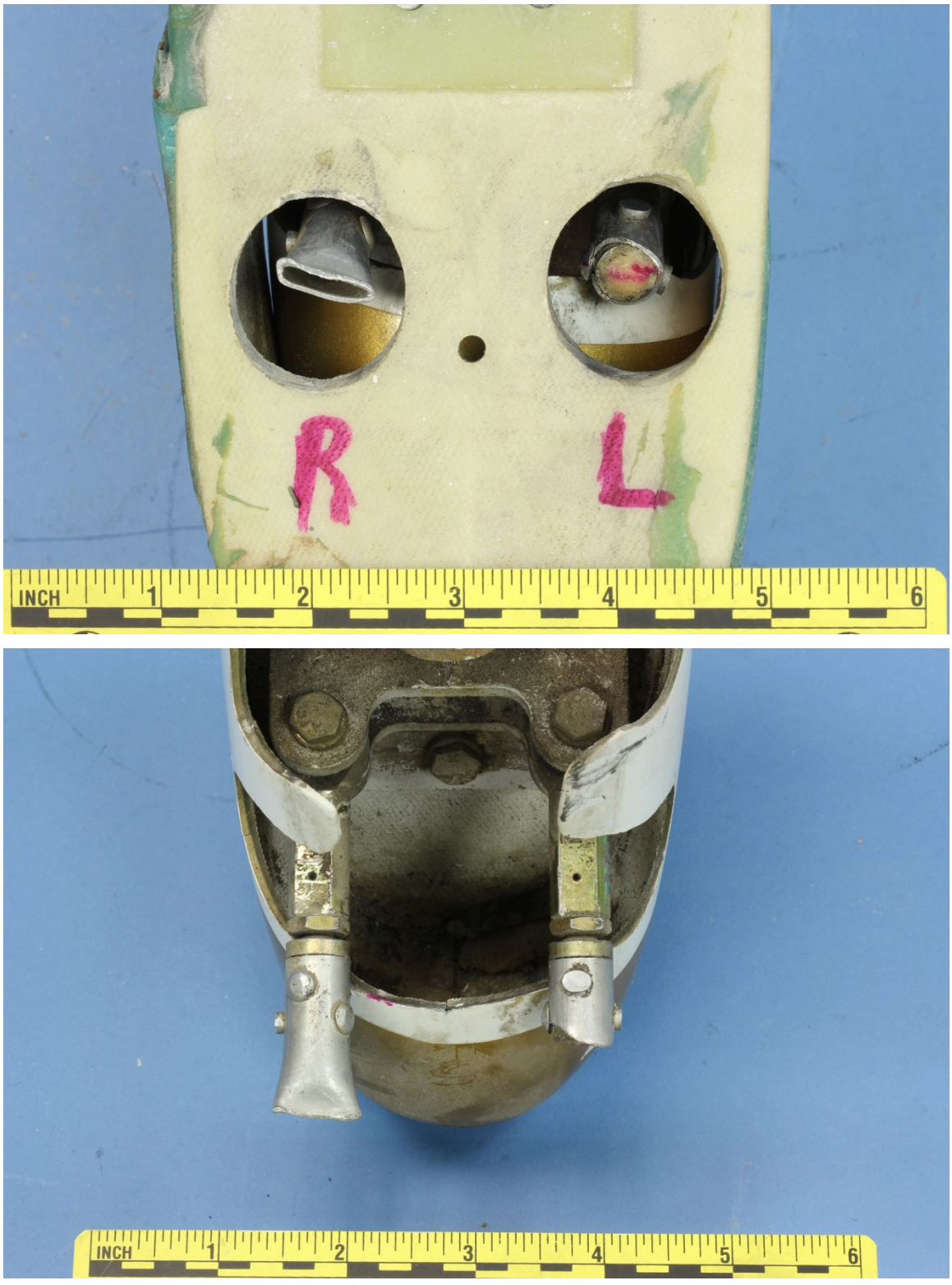

Figure 3: Closer views of the pieces of the fractured left and right push-pull rods that were attached to the rudder; a) end-on view showing the rod fracture surfaces and b) after removal of the vertical stabilizer bulkhead showing how the rod ends were fully inserted into the female-threaded rod end bearings.

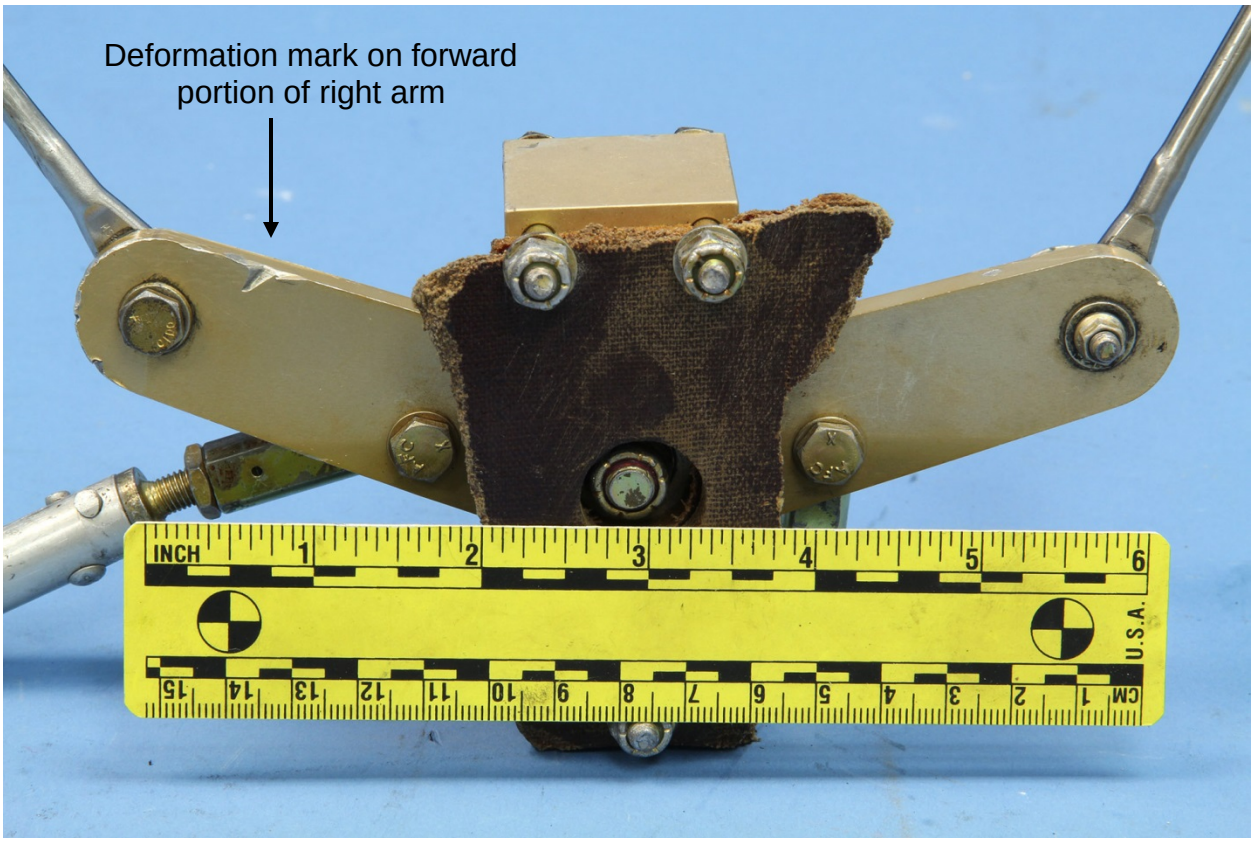

Figure 4: Image of the underside of the rudder bellcrank where a deformation mark on the forward portion of the right arm in the vicinity of the bellcrank stop was observed.

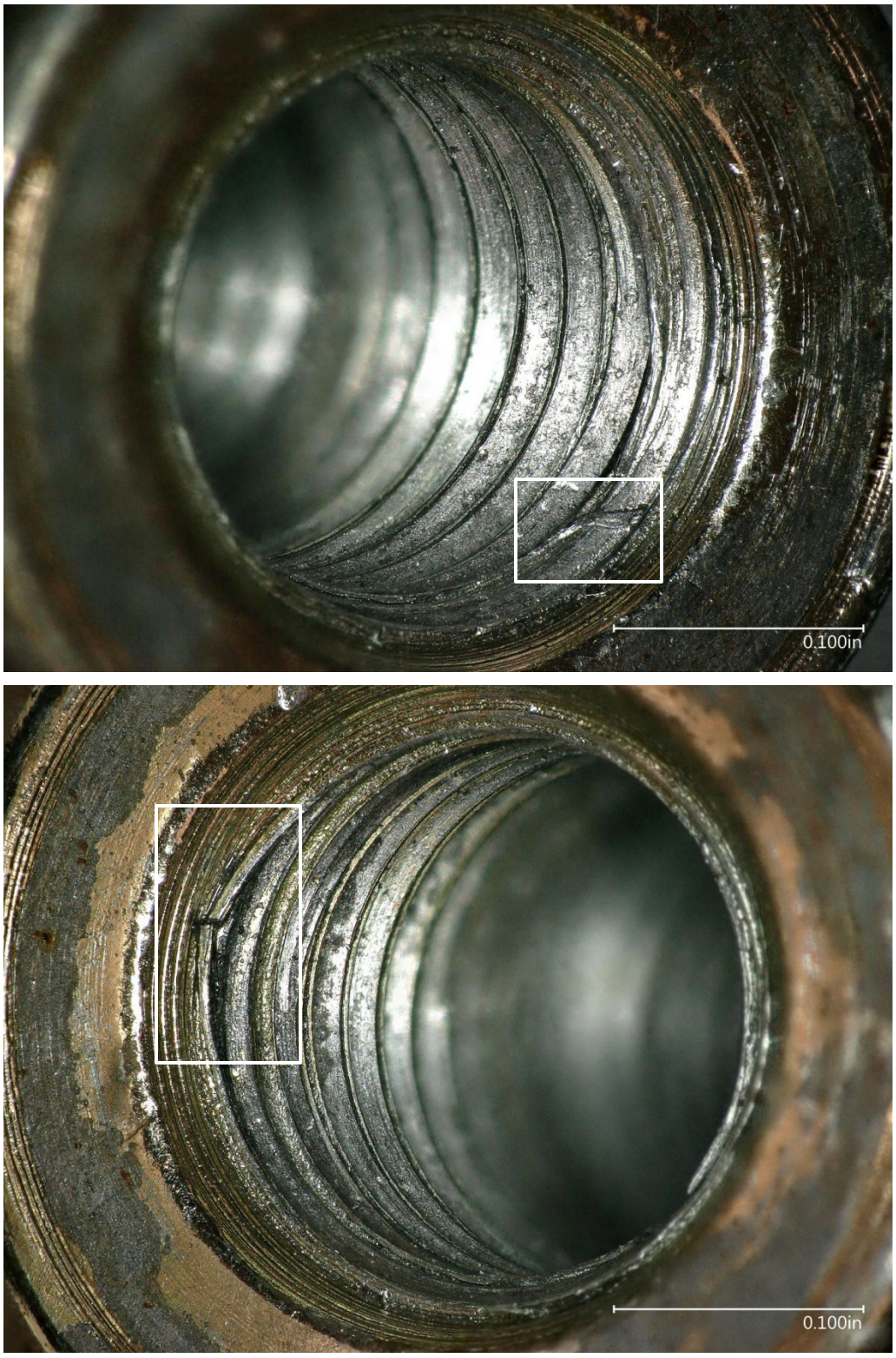

Figure 5: Digital microscope images of the left bellcrank rod end bearing female threads. White rectangles indicate two isolated spots where deformation was observed along the outermost thread.

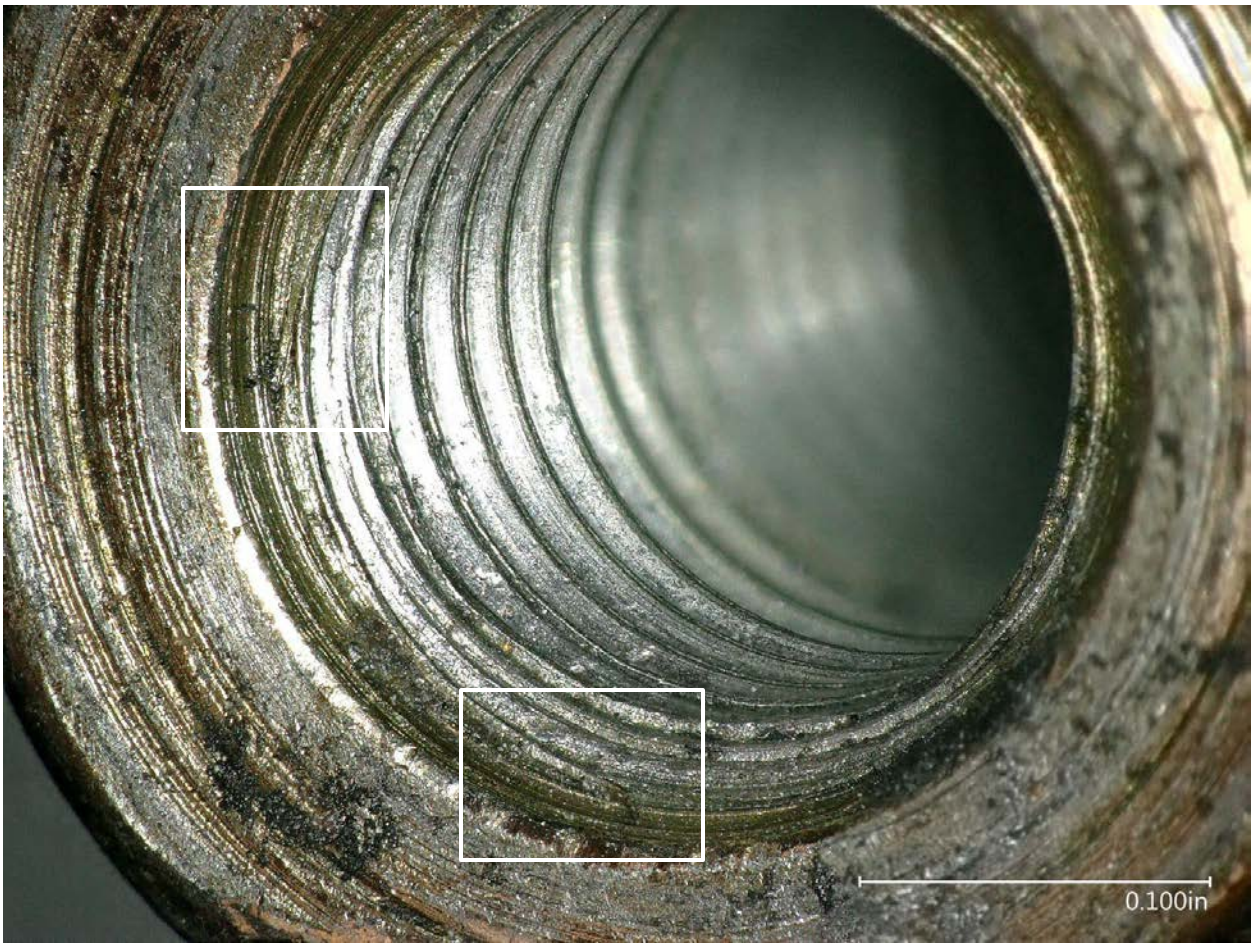

Figure 6: Digital microscope image of the right bellcrank rod end bearing female threads. White rectangles indicate two isolated spots where deformation was observed along the outermost thread.