

NATIONAL TRANSPORTATION SAFETY BOARD

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



April 3, 2019

MATERIALS LABORATORY FACTUAL REPORT

Report No. 19-014

A. ACCIDENT INFORMATION

Place : Kansas City, MO
Date : March 22, 2018
Vehicle : Cessna 310R (N372WP)
NTSB No. : CEN18LA128
Investigator : Jim Silliman (AS-CEN)

B. COMPONENTS EXAMINED

Landing gear hardware

C. DETAILS OF THE EXAMINATION

After the right landing gear of a Cessna 310R collapsed during landing roll, several pieces of separated landing gear hardware were submitted to the NTSB Materials Laboratory for examination. An image of the breakout drawing for the main gear retraction linkage installation from the Cessna Model 310R illustrated parts catalog (IPC) is shown in Figure 1. The number labels from the breakout drawing are recorded after the name of each piece of submitted hardware below:

- End fitting bolt (76) with mating spacer (90) and bushing (104)
- End fitting assembly (75) with mating adjusting screw (74) and nut
- Bellcrank assembly bolt (63) with mating nut
- Part of a flange from an unknown component

Figure 2 shows an overall photo of the submitted hardware.

The end fitting bolt had separated through a thread root on the end of the bolt. The bolt was bent, which prevented easy removal of the mating spacer and bushing. The bend in the bolt is illustrated by the red dotted lines in Figure 2. Figure 3 shows the fracture surface on the bolt. The fracture surface was approximately flat, but significant smearing and secondary damage obscured the finer features. Two crescent-shaped marks on the fracture surface (blue arrows) aligned with mounded material on the sides (red arrows), which was consistent with impact damage. The exact cause of the end fitting bolt separation could not be determined.

The end fitting adjustment screw, shown in Figure 4, had separated across a few threads and had a slight cup and cone configuration to the fracture surfaces. The fracture

surface features were rough and consistent with overstress. The orientation and shape of the fracture surfaces was consistent with torsional overstress.

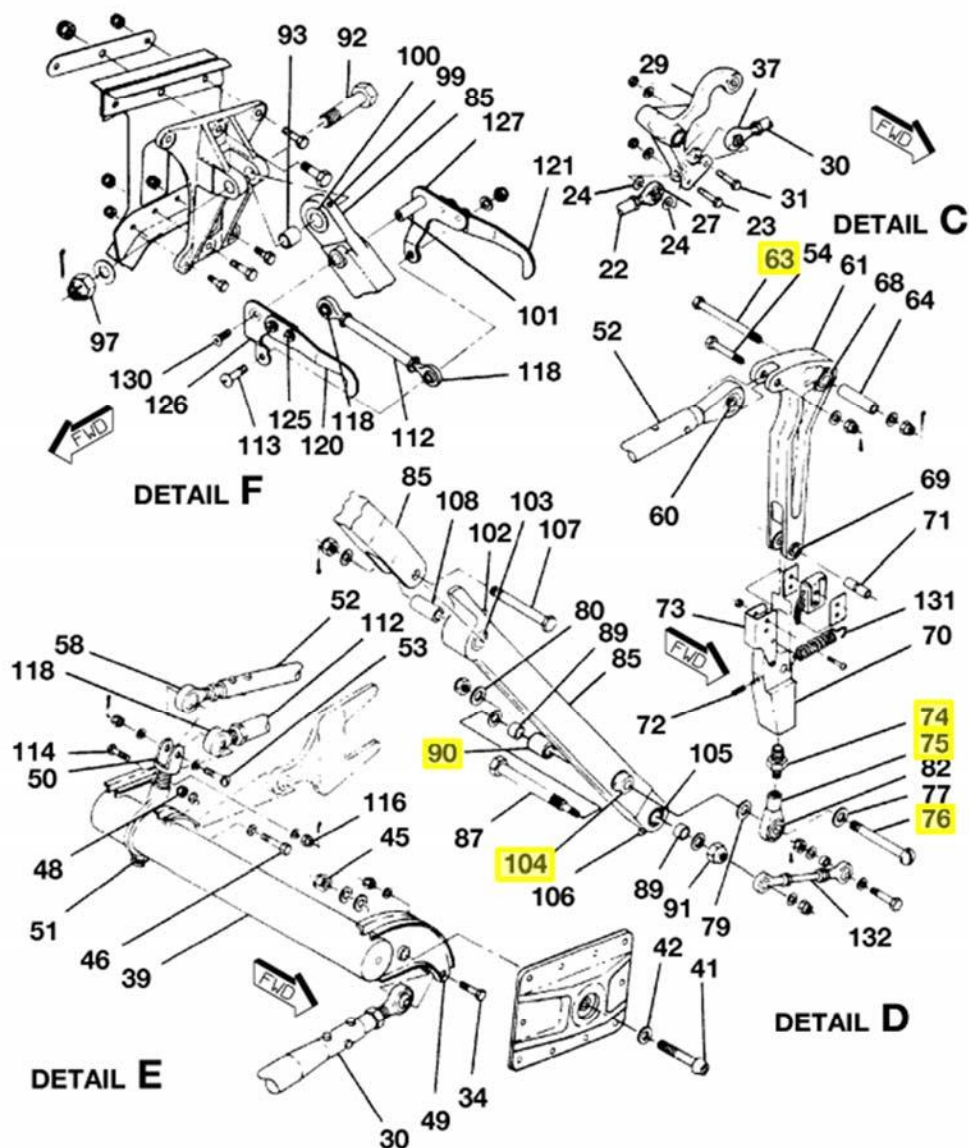
The bellcrank assembly bolt pieces are shown in profile in Figure 5. The fracture surfaces had evidence of necking (red arrows) on one side and slight mushrooming (yellow brackets) on the other side. The fracture surfaces matched such that the necking on one piece mated to the mushrooming on the other piece (i.e. the necking on the head side of the bolt mated to the mushrooming on the threaded end side of the bolt). These features were consistent with shear deformation. The fracture surfaces on the bolt pieces are shown in Figure 6. The fracture surface features were consistent with overstress. Smearing damage on the fracture surfaces was consistent with a shearing motion.

The flange piece separated through the hole, as shown in Figure 7, but the two fracture surfaces were not circumferentially aligned (one side was through a thicker portion of the flange than the other). One half of the piece was deformed out of plane, as indicated by the white arrow. The fracture surfaces had shear lips and features consistent with fast fracture overstress. The deformation and overstress were consistent with separation due to impact.

Adrienne V. Lamm
Materials Engineer

CESSNA AIRCRAFT COMPANY
MODEL 310R
ILLUSTRATED PARTS CATALOG

A56225



C10413005
D14413003
E52412001
F14411001

MAIN GEAR RETRACTION LINKAGE INSTALLATION
FIGURE 01 (SHEET 2)

Figure 1: Image of the breakout drawing for the main gear retraction linkage installation from the Cessna Model 310R IPC. The yellow boxes highlight the numbers associated with the submitted parts.

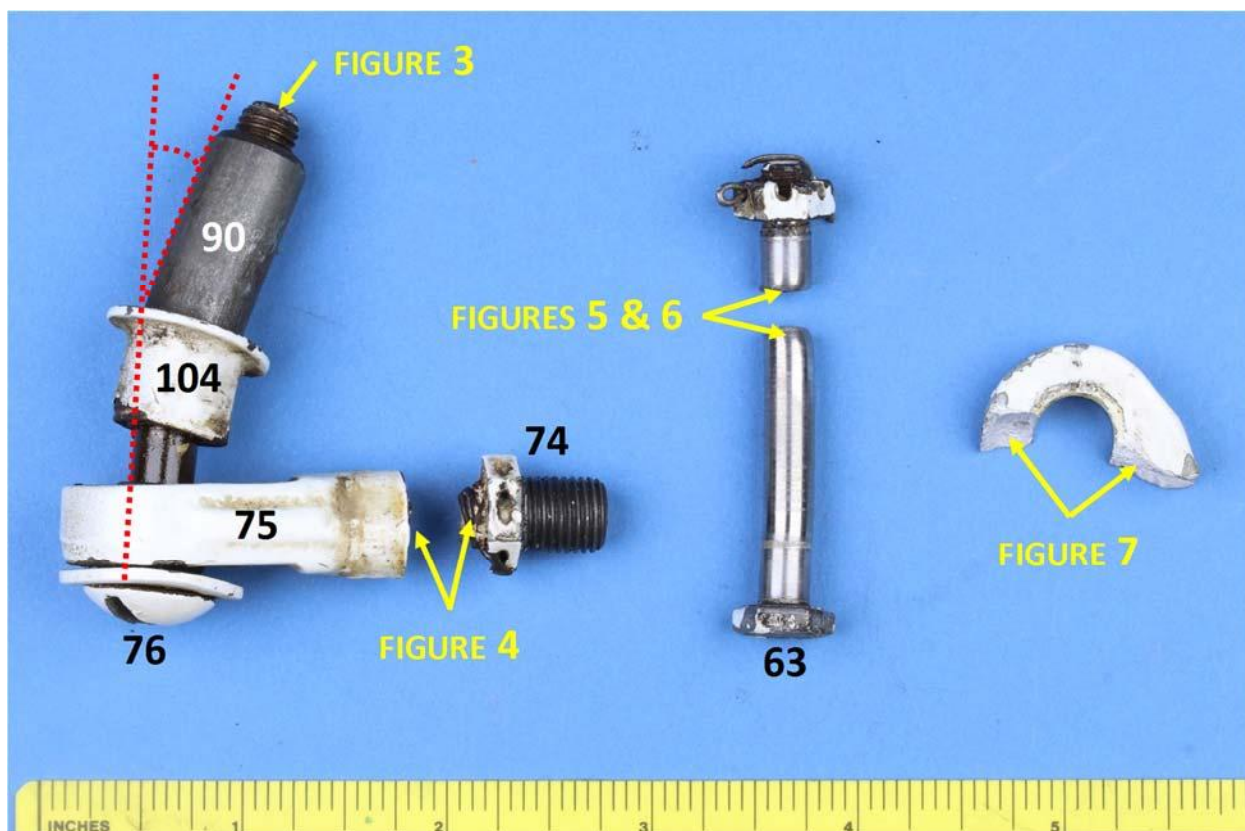


Figure 2: Overall photo of the submitted hardware. The red dotted lines indicate the bend in the end fitting bolt. The fracture surfaces of the pieces are shown in the figures indicated.

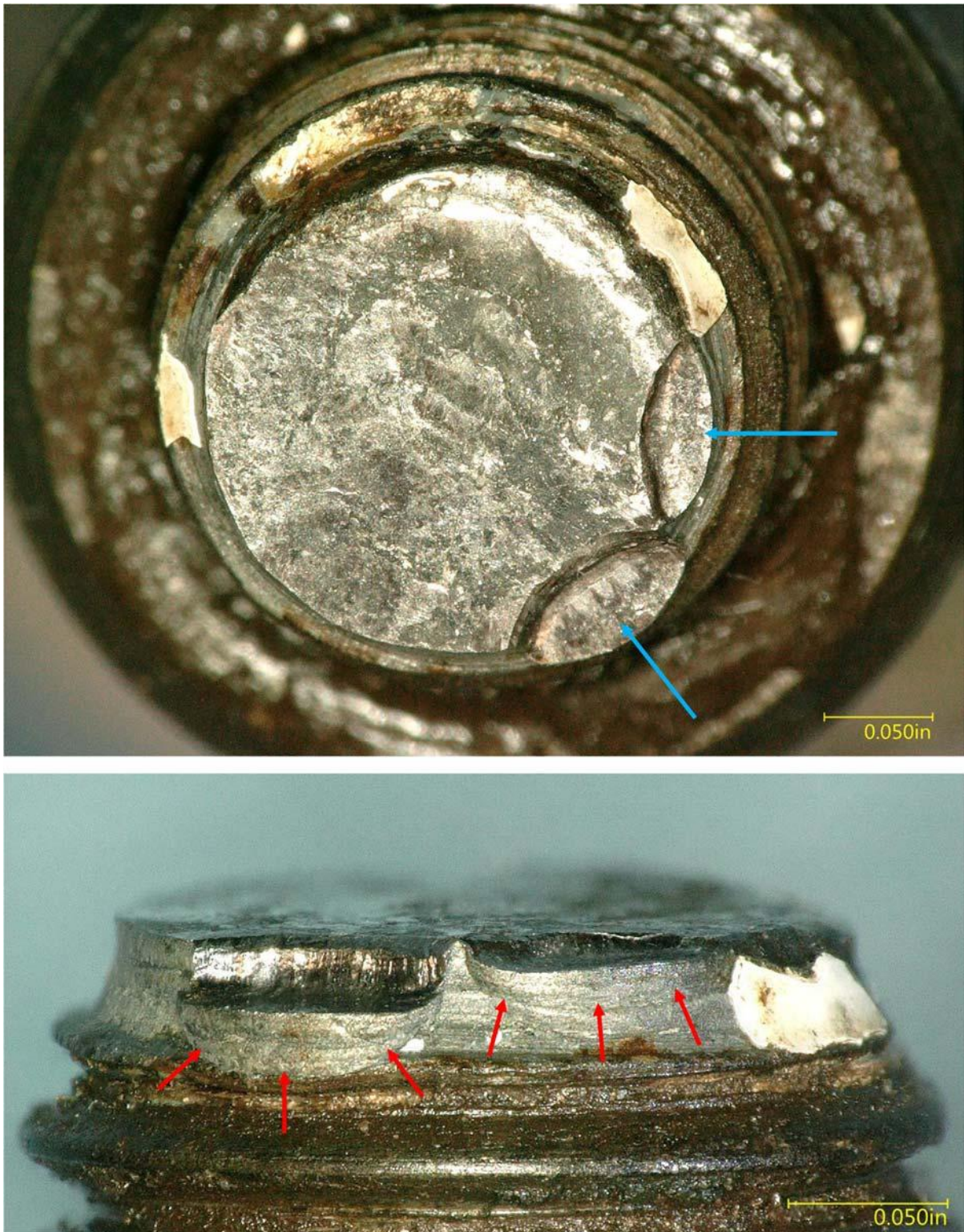


Figure 3: Digital microscope images of the end fitting bolt fracture surface (top) and profile (bottom). The blue arrows point to two crescent-shaped marks on the fracture surface. The red arrows point to mounded material adjacent to the crescent-shaped marks.

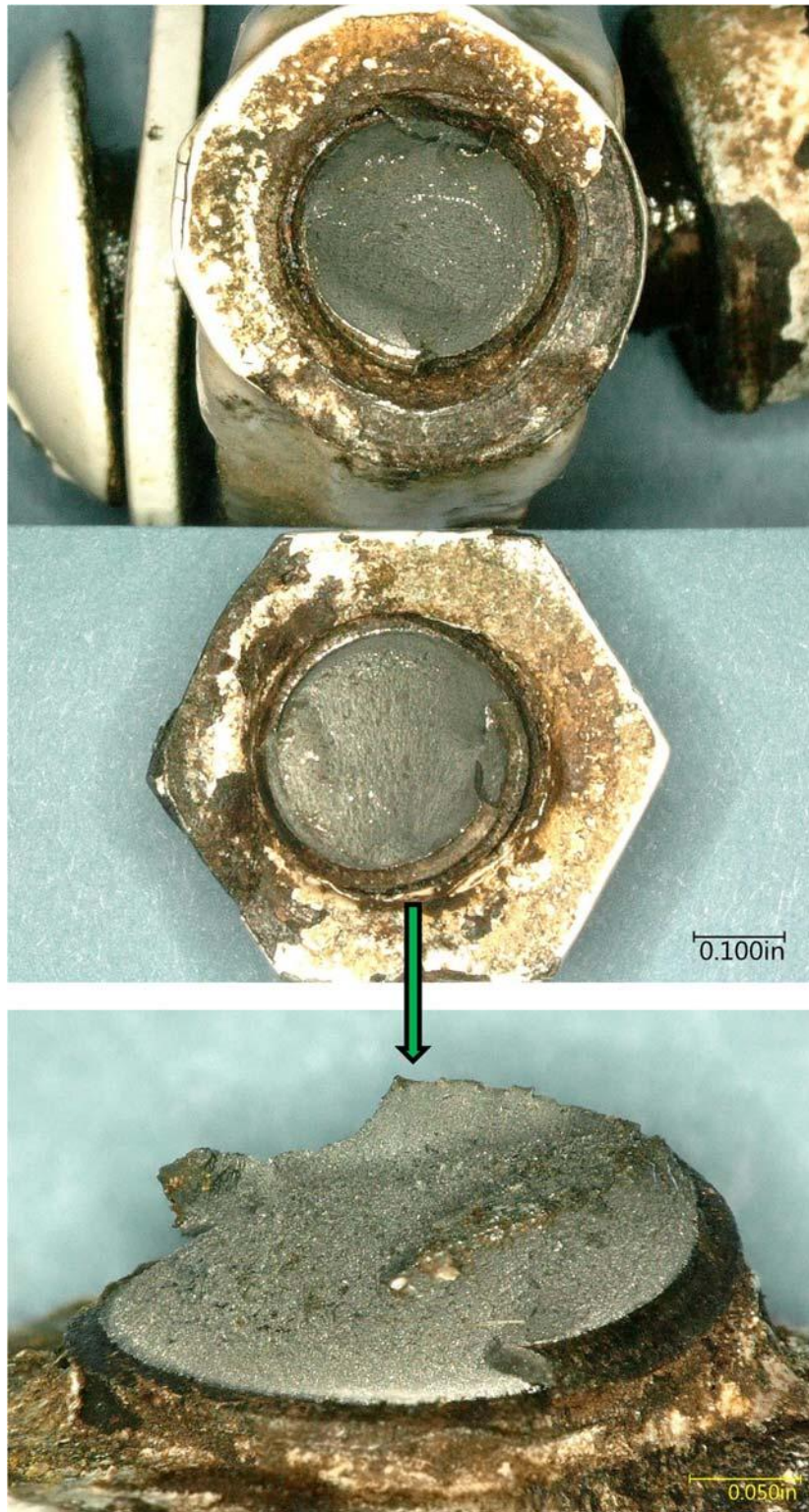


Figure 4: Digital microscope images of the fracture surfaces on the mating halves of the separated end fitting adjustment screw.

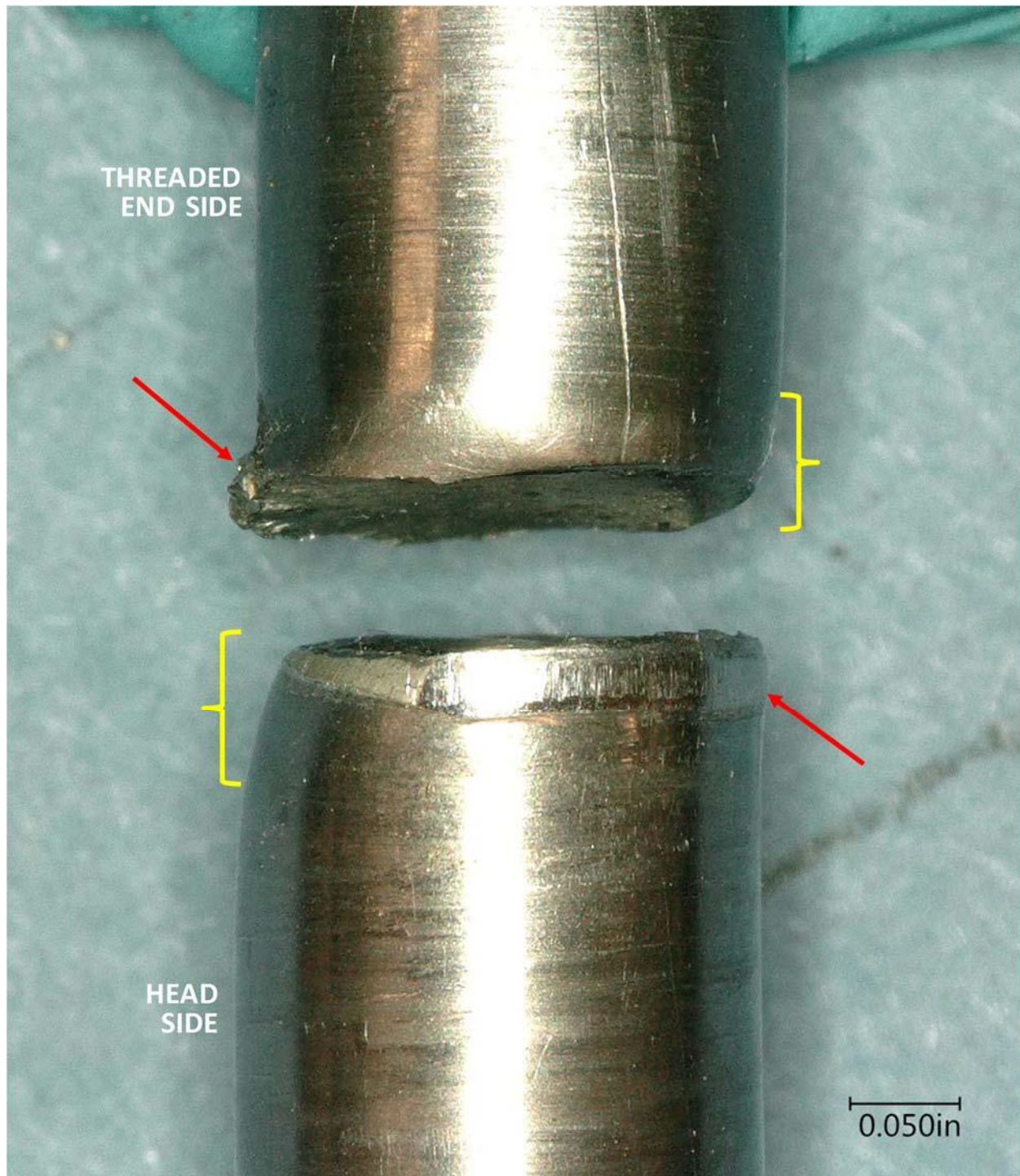


Figure 5: Digital microscope image of the mating bellcrank assembly bolt pieces as viewed in profile. The red arrows point to necking and the yellow brackets indicate slight mushrooming adjacent to each fracture surface.



Figure 6: Digital microscope images of the fracture surfaces on the bellcrank assembly bolt pieces.



Figure 7: Digital microscope images of the flange piece. The white arrow indicates the out of plane deformation of one half of the piece.