

NATIONAL TRANSPORTATION SAFETY BOARD

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



August 8, 2013

MATERIALS LABORATORY FACTUAL REPORT

Report No. 13-062

A. ACCIDENT INFORMATION

Place : Flushing, NY
Date : July 22, 2013
Vehicle : Boeing 737-700, N753SW
NTSB No. : DCA13FA131
Investigator : Dennis Jones, AS-10

B. COMPONENTS EXAMINED

- 1) Fractured piece of nose landing gear left axle;
- 2) Three fractured pieces of nose landing gear lower drag brace bolt.

C. DETAILS OF THE EXAMINATION

The fractured pieces of the nose landing gear left axle and lower drag brace bolt were received by the lab as shown in figures 1a and 1b, respectively. The left axle was fractured in the transverse plane approximately 0.25 inch inboard of the inboard chrome-plated bearing journal. There was also a longitudinal fracture that started at the transverse fracture and extended approximately 2.2 inch in the outboard direction. The drag brace bolt was fractured in three pieces. The middle piece measured approximately 1.1 inch in the longitudinal direction at its longest and was positioned near the midway point along the length of the bolt. The other two pieces had fracture surfaces that matched those on the opposing ends of the middle piece. The fracture surfaces were cleaned using a soft-bristled brush and an alkaline detergent, sonicated in acetone, and viewed using a stereomicroscope.

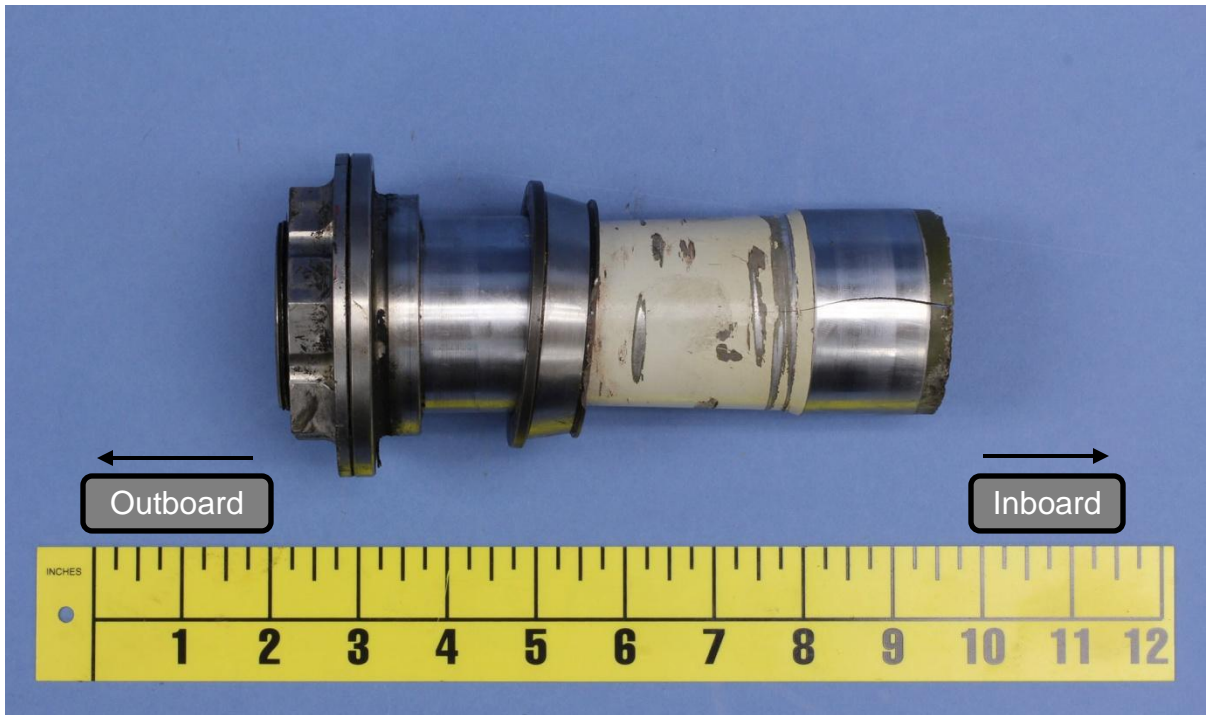
The transverse fracture through the left axle is shown in figure 2a. Viewed under the stereomicroscope, chevron marks and radial lines were observed that pointed back toward the fracture initiation site. A higher magnification image of the initiation site is shown in figure 2b, with the direction of crack propagation indicated by yellow arrows. The radial lines were traced back to a single point near the outer surface of the axle wall. The radial lines were also observed to be continuous across the longitudinal fracture, which was located near the initiation site. Along the outer surface of the wall, the fracture plane was inclined by 45° to the transverse plane. The features were consistent with a bending overstress fracture. No preexisting defects were observed.

The fractures through the drag brace bolt are shown in figures 3a and 3b. Portions of each fracture surface lied in the transverse plane, were comparatively

reflective (compared to the rough appearance of a typical tensile overstress fracture), and exhibited parallel smear features consistent with shear deformation. Other portions of the fractures followed a 45° spiral plane about the bolt's longitudinal axis. The two bolt end pieces exhibited mirrored deformation bends near the middle fragment as shown in figure 1b. The features were consistent with an overstress fracture under shear and torsion. No preexisting defects were observed.

The hardness of the axle and of the drag brace bolt was measured using a Rockwell hardness tester. Two transverse sections were cut through the landing gear axle and one transverse section was cut through the drag brace bolt. The first section through the axle was cut approximately 0.6 inch from the fracture in the adjacent chrome-plated journal region. The second section was cut in the painted region between the two journals outboard of end of the longitudinal fracture. The drag brace bolt was sectioned adjacent to the hexagonal head. The sections were ground using wet SiC grinding papers through 600 grit and the hardness was measured on each section 5 or 6 times in accordance with ASTM E18 – 03e1. The average hardness and standard deviation of the axle was 55 HRC \pm 1 HRC and 54 HRC \pm 0 HRC in the chrome-plated and painted regions, respectively. The average hardness and standard deviation of the drag brace bolt was 54 HRC \pm 0 HRC. All hardness values were within the limits of the material specification.

Donald Kramer, Ph.D.
Sr. Materials Engineer



a)



b)

Figure 1: a) Fractured piece of nose landing gear left axle, as received; b) the three fractured pieces of the nose landing gear lower drag brace bolt, as received.

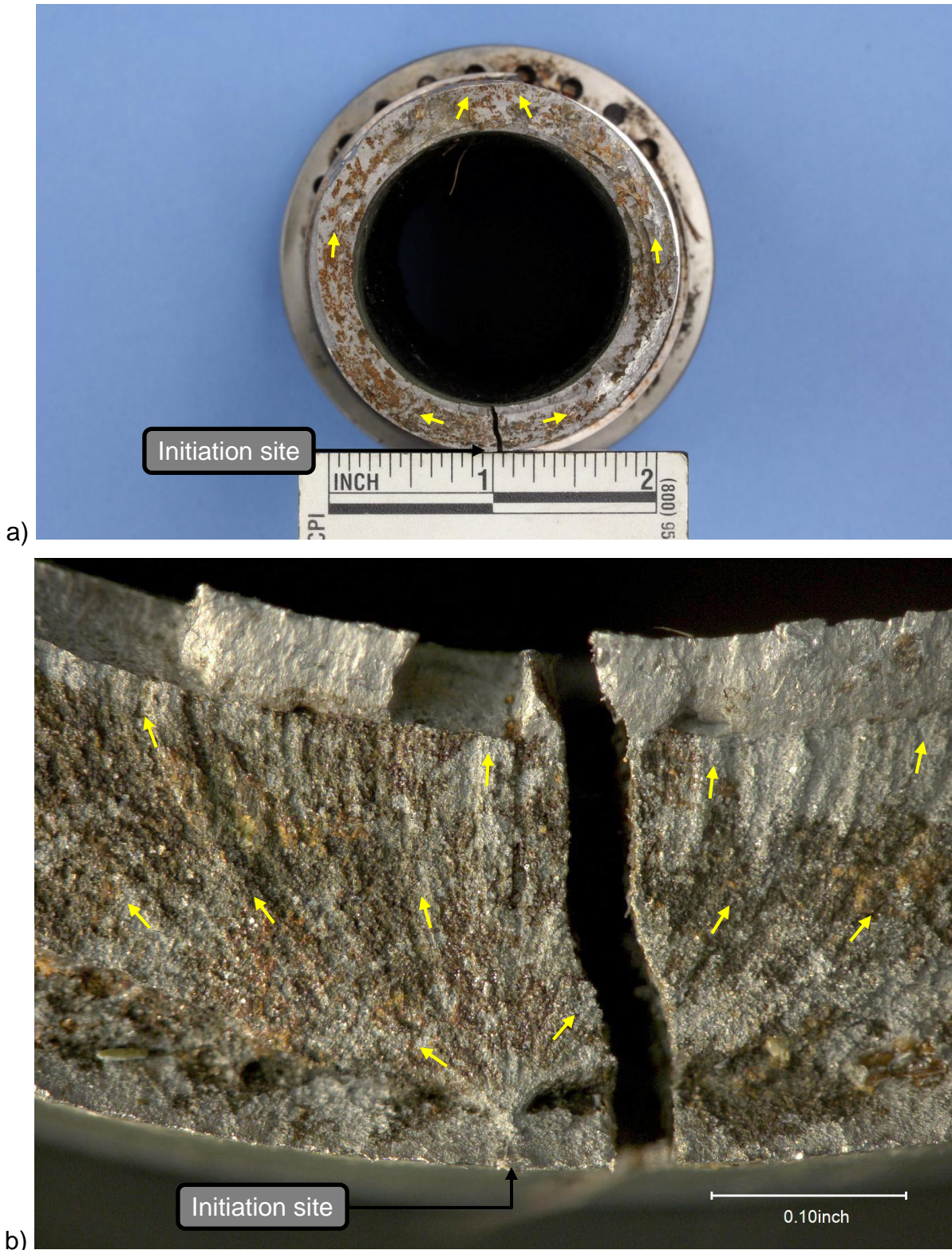
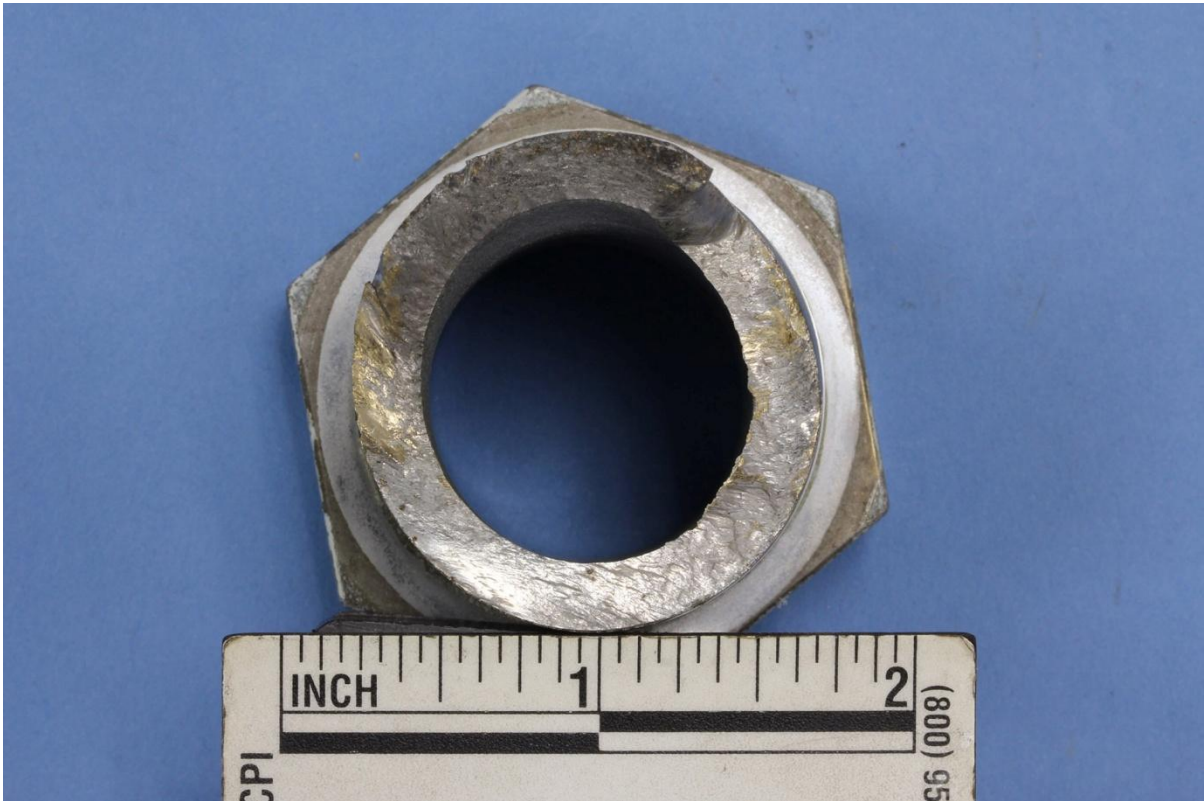


Figure 2: a) Image of the left axle fracture surface; b) higher magnification image of the fracture initiation site. The direction of crack propagation is indicated by yellow arrows.



a)



b)

Figure 3: Images of the lower drag brace bolt fractures; a) fracture on the hex head end of the bolt; b) fracture on the threaded end of the bolt.