

NATIONAL TRANSPORTATION SAFETY BOARD

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



October 25, 2017

MATERIALS LABORATORY FACTUAL REPORT

Report No. 17-078

A. ACCIDENT INFORMATION

Place : Arlington, Texas
Date : September 22, 2017
Vehicle : Union Pacific Railroad train Y-GW51R-22
NTSB No. : DCA17FR013
Investigator : Georgetta Gregory, RPH-10

B. COMPONENTS EXAMINED

Joint bar attachment bolt piece, nut, and washer.

C. DETAILS OF THE EXAMINATION

An overall view of the submitted joint bar attachment bolt piece, nut, and washer are shown in figure 1. The bolt was fractured through the threaded shank in a plane approximately coinciding with the clamping face of the nut. The nut remained attached to the submitted bolt piece as shown in figure 1.

An overall view of the bolt fracture face is shown in figure 2. A portion of the fracture surface was relatively smooth with dark oxides, features consistent with fatigue cracking. Curving crack arrest lines were observed emanating from multiple origins at one side of the bolt. A bracket in figure 2 indicates the approximate origin area. Step features consistent with ratchet marks¹ were observed at the origin area, consistent with multiple origins. A dashed line in figure 2 indicates the fatigue boundary. The remainder of the fracture surface was rough and mostly covered with orange oxides, features consistent with overstress fracture followed by oxidation of the exposed fracture surface.

The image of the fracture surface shown in figure 2 was analyzed to determine the extent of fatigue cracking prior to overstress fracture. The number of pixels associated with the fatigue region was compared to the number of pixels associated with the entire fracture surface, and the area percentage was calculated from the pixel counts. The estimated size of the fatigue region relative to the cross-sectional area in the plane of fracture was approximately 78%.

Contact surfaces for the washer are shown in figures 1 and 3. Relatively shiny gray areas were observed corresponding to contact with the joint bar (surface shown in

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) and the nut (surface shown in figure 3). The areas of wear contact are indicated with brackets and arrows on each face. As shown in figures 1 and 3, the contact areas were observed around approximately 75% of the circumference on each side of the washer.

A side view of the washer at the split line is shown in figure 4. Dashed lines indicate the orientations of planes associated with wear surfaces on either side of the split line. The planes of wear were angled relative to each other with the spring in the unloaded position as shown in figure 4.

Matthew R. Fox, Ph.D.
Senior Materials Engineer



Figure 1. Overall view of the submitted components.



Figure 2. Close view of the bolt fracture surface. A bracket indicates the fatigue origin area, and a dashed line indicates the fatigue boundary.



Figure 3. Close view of the face of the washer spring mating to the nut face. Areas of wear are indicated with brackets.

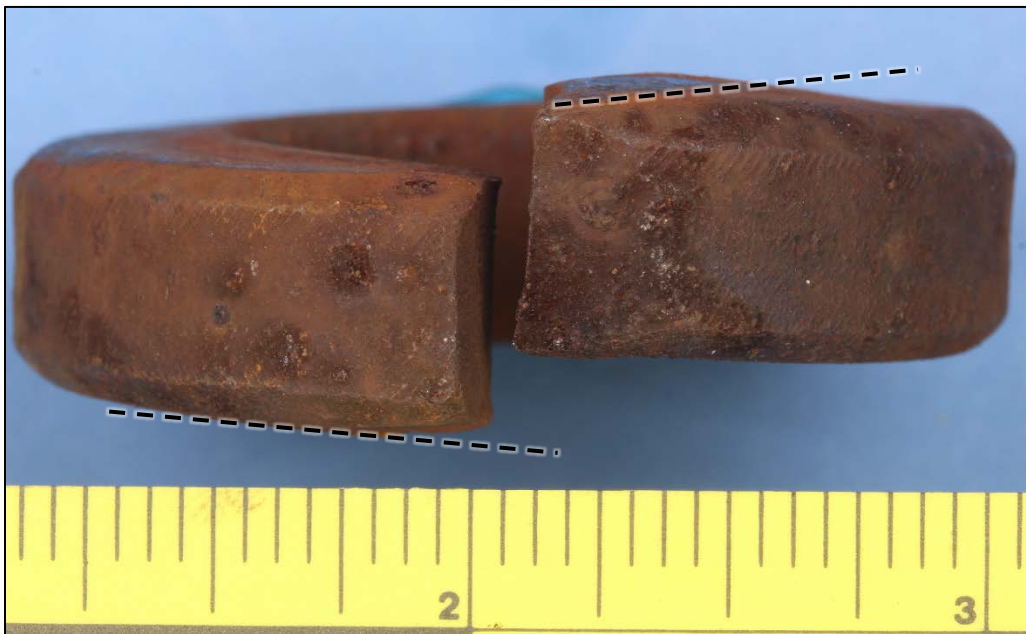


Figure 4. Side view of the washer. Dashed lines indicate planes of wear on either side of the split with the split in the washer sprung open as shown.