

# NATIONAL TRANSPORTATION SAFETY BOARD

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



January 27, 2016

MATERIALS LABORATORY FACTUAL REPORT

Report No. 16-005

## A. ACCIDENT INFORMATION

Place : Houston, Texas  
Date : September 15, 2015  
Vehicle : School bus  
NTSB No. : HWY15FH010  
Investigator : Daniel Walsh, OHS

## B. COMPONENTS EXAMINED

Railing post anchor pieces from the south parapet.

## C. DETAILS OF THE EXAMINATION

An overall view of the submitted rail post anchor pieces are shown in figure 1. The pieces were from the south barrier of the eastbound Interstate 610 highway bridge over Telephone Road. The barrier consisted of a steel rail installed on a concrete parapet. As installed, the rail posts on the bridge parapet are spaced approximately 10 feet apart. Each post is anchored with 2 steel u-bolts with the "U" oriented transverse to the direction of traffic and with the open end pointed upward.

The pieces shown in figure 1 were the south legs (legs of the "U" further from traffic) from 3 of the u-bolt anchors embedded in the concrete parapet. The pieces were received labeled 10' W, 20' W, and 20' E as shown in figure 1. The piece labeled 10' W was from the west u-bolt on the first post east of the expansion joint between bridge spans 1 and 2. The pieces labeled 20' W and 20' E were from the west and east u-bolts, respectively, anchoring the second rail post east of the same expansion joint.

According to engineering drawings of the barrier provided by the Texas Department of Transportation, the u-bolts have a nominal diameter of  $\frac{3}{4}$  inch. The posts are attached with a nut and 2 washers at each of the upper ends of the u-bolts. All metal components of the barrier were to be galvanized.

The lower ends of each of the submitted u-bolt pieces had cut ends. All 3 pieces were bent to varying extents and had varying levels of corrosion. Portions of each bolt had a light gray exterior consistent with a zinc coating. Analysis of the coating using a Thermo Scientific Niton XL3t-980 x-ray fluorescence (XRF) alloy analyzer showed a composition of approximately 90 percent zinc with small amounts of lead and iron.

The nut remained attached to piece 10' W as shown in figure 1. One washer was also received with piece 10' W. The upper side of the washer had an impression pattern consistent with contact with the edges of the nut, and the lower side of the washer had an impression pattern consistent with contact with the slotted attachment hole at the base of the rail post. Thread remnants were trapped within the threads at the upper ends of pieces 20' W and 20' E consistent with sheared threads from the attachment nuts on those u-bolts segments.

The pieces showed substantial corrosion including reduced diameter, particularly in the area near the lower end of the threads. Corrosion on the surface of piece 10' W was observed around the circumference up to 4.51 inches from the upper end of the piece. On pieces 20' W and 20' E, corrosion was observed along the entire length of the pieces on the side of the piece on the outside of the bend; up to 8.30 inches from the upper end of piece 20' W and 9.04 inches from the upper end of piece 20' E. At the inside of the bend, corrosion was present up to 4.35 inches from the upper end of piece 20' W and up to 2.79 inches from the upper end of piece 20' E.

Using calipers, the diameters of the u-bolt pieces were measured at multiple locations along the length, namely at the lower end near the cut location, at the upper end in undamaged threads, and at the area at the lower end of the threads where the smallest diameter was noted in each piece. Results of the measurements are listed in table 1. At the location of the smallest diameter, the diameter was not uniform around the circumference, and measurements were taken both across the smallest remaining section and across a diameter orthogonal to the smallest diameter. The diameter was also not uniform around the circumference at the lower end of pieces 20' W and 20' E, and diameter measurements across the corroded section and across the diameter with intact zinc are each listed as noted in table 1.

Table 1. Diameter Measurements

<b>Piece</b>	<b>Diameter near Lower End (inch)</b>	<b>Diameter in Threads (inch)</b>	<b>Minimum Diameter (inch)</b>	<b>Diameter Orthogonal to Minimum (inch)</b>
<b>10' W</b>	0.677	0.733	0.494	0.585
<b>20' W</b>	0.642 (corroded) 0.685 (zinc)	0.732	0.466	0.565
<b>20' E</b>	0.670 (corroded) 0.678 (zinc)	0.727	0.571	0.700

A transverse cross-section of each of the u-bolt pieces was prepared for metallographic examination near the lower end of each piece. The cross-sections were mounted in an edge-retaining compound, polished, and then lightly etched with a 2% Nital etchant. Results showing representative images of the zinc coating on each piece are shown in figures 2 through 4. The zinc coating was fairly uniform around most of the diameter on piece 10' W appearing similar to that shown in figure 2. The coating on pieces 20' W and 20' E was generally thinner and showed more variability in the thickness around the circumference and was missing from a quarter to a third of the circumference.

The zinc coating thickness was measured on each piece at 8 positions around the circumference. Results of the coating thickness measurements are listed in table 2. In cases such as that shown in figure 4 where variability was observed within the image, the thinnest area within the view at the magnification shown in images 2 through 4 was measured and listed in table 2.

Table 2. Zinc Coating Thickness at Eight Locations on Each Piece

<b>Piece</b>	<b>#1 (inch)</b>	<b>#2 (inch)</b>	<b>#3 (inch)</b>	<b>#4 (inch)</b>	<b>#5 (inch)</b>	<b>#6 (inch)</b>	<b>#7 (inch)</b>	<b>#8 (inch)</b>
<b>10' W</b>	0.034	0.028	0.012	0.048	0.048	0.029	0.034	0.005
<b>20' W</b>	0.027	0.028	0.008	0.003	0.042	0.000	0.000	0.000
<b>20' E</b>	0.019	0.016	0.023	0.023	0.029	0.017	0.000	0.000

Matthew R. Fox  
Senior Materials Engineer

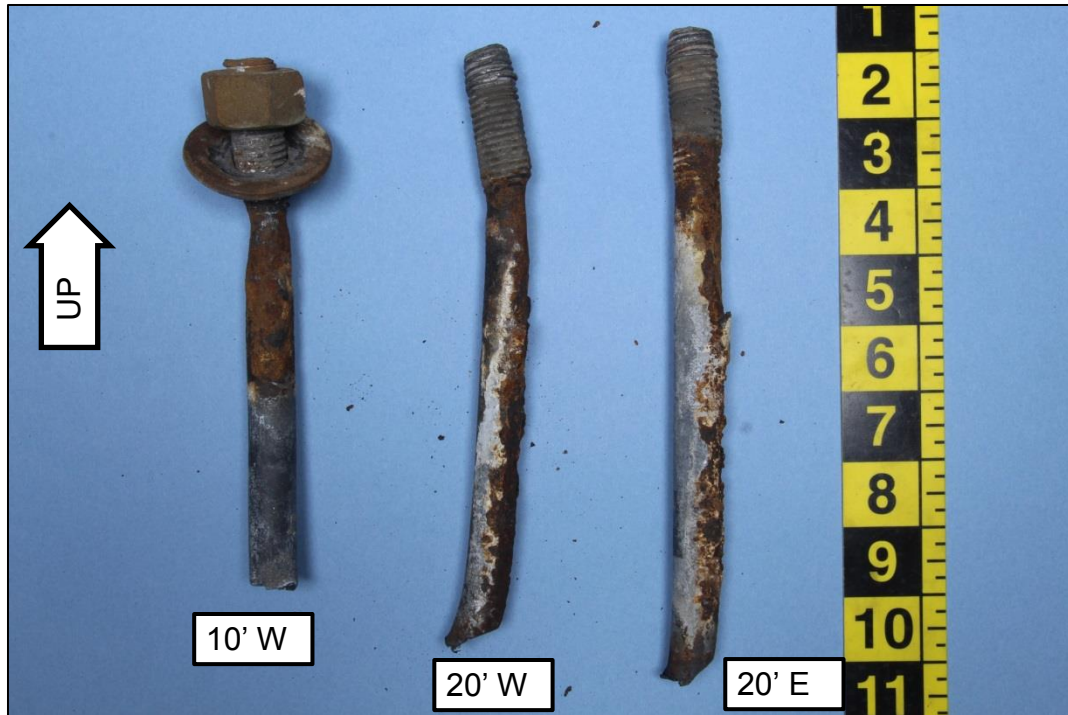


Figure 1. Overall view of the submitted u-bolt pieces.

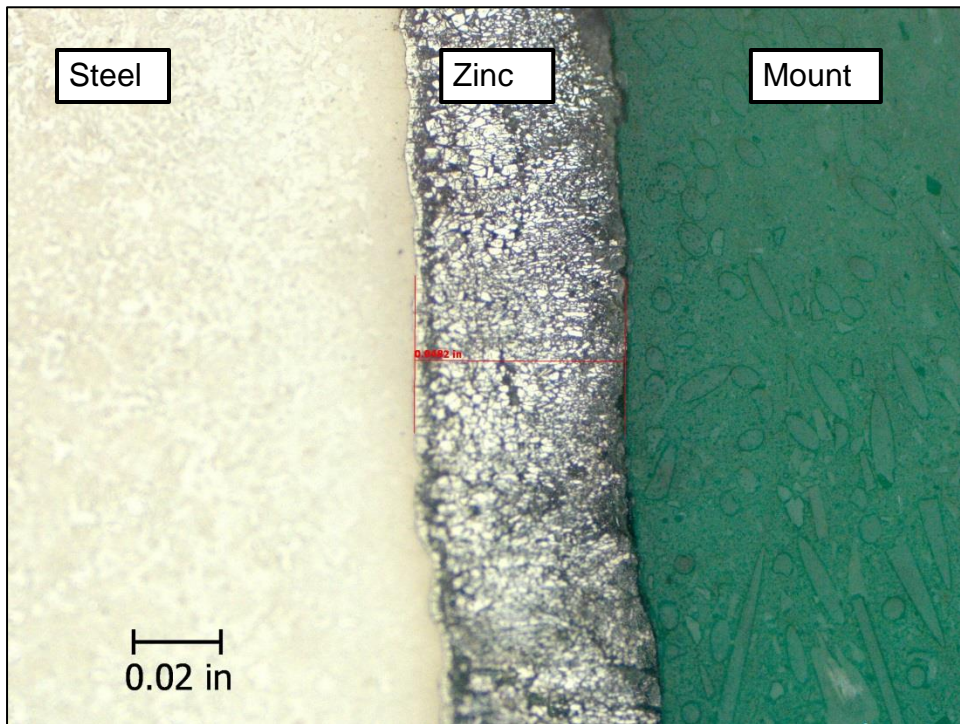


Figure 2. Metallograph showing the zinc coating on piece 10' W.

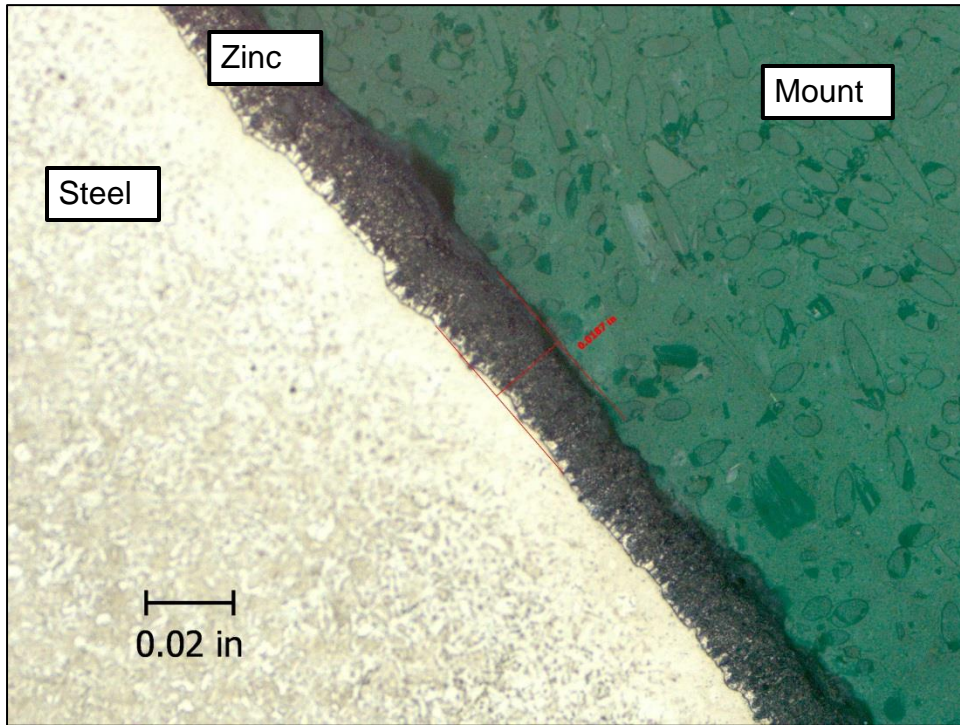


Figure 3. Metallograph showing the zinc coating on piece 20' W.

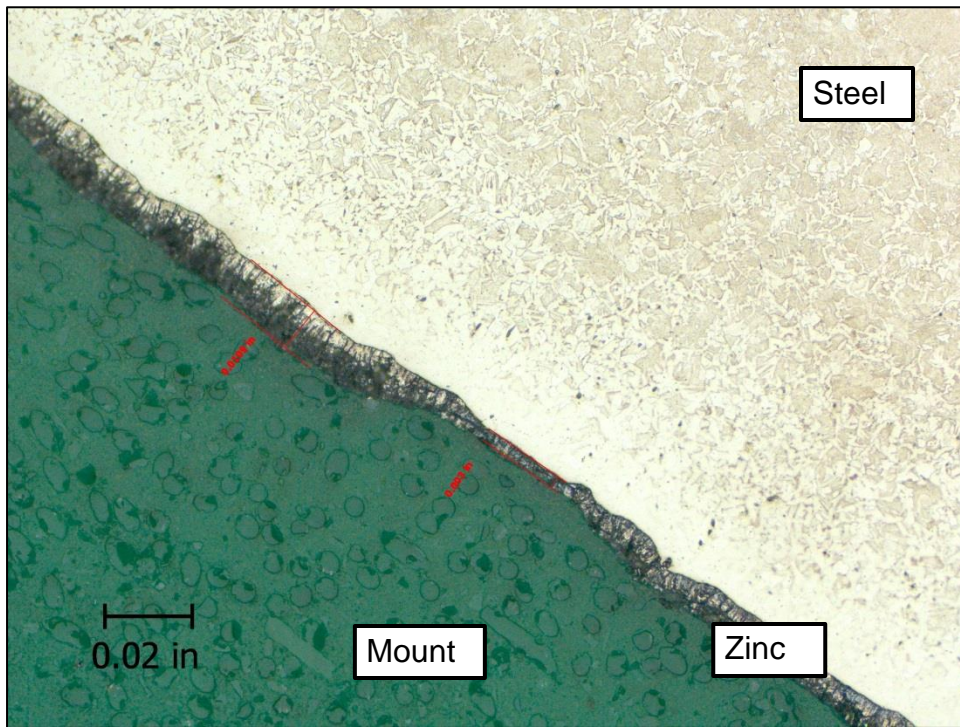


Figure 4. Metallograph showing the zinc coating on piece 20' E.