

NATIONAL TRANSPORTATION SAFETY BOARD

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

November 14, 2017



MATERIALS LABORATORY FACTUAL REPORT

Report No. 17-074

A. ACCIDENT INFORMATION

Place : Glendale, Arizona
Date : August 22, 2017
Vehicle : Enstrom F-28F, N52PD
NTSB No. : WPR17IA198
Investigator : Albert Nixon

B. COMPONENTS EXAMINED

Turbo V-clamp assembly.

C. DETAILS OF THE EXAMINATION

Figures 1 and 2 show photographs of the as-received V-clamp assembly, also referred in industry as a V-band clamp assembly. The assembly contained no evidence of an identification mark such as a part number or manufacturer name. The cross section of the retainer portion resembled the shape of a "V" character. The V-clamp assembly contained an outer strap portion and two V-shaped retainers. The two V-shaped retainers are located on the inner side of the strap portion. The bottom end of each V-shaped retainer was joined by two spot welds to the inner side of the strap portion. Examination of the clamp assembly revealed the two V-shaped retainer portions were attached to the clamp. Bench binocular microscope examination of the outer face of the strap portion revealed that three of the four spot welds contained a crack at the outer edge of the spot weld (nugget portion), see figure 3. The length of the longest spot weld crack ("W2") on the outer face measured approximately 0.17 inch. The edge of the strap portion in areas next to latch mechanism and diametrically opposite of the latch mechanism showed evidence of bending deformation that was toward the edge of the V-shaped retainer, see areas between arrows "D1" through "D3" in figure 1. In the deformed areas, the distance between the edge of the retainer and the edge of the strap were smaller compared to other non-deformed areas. This bending deformation damage was apparent on both sides (edges) of the assembly. The width of the retainers at the ends (see "Y1" in figure 2) was slightly wider compared to areas located midway between the ends of the retainers (see "Y2" in figure 2). The difference in width is also shown in figure 4. The strap was attracted to a magnet indicating it was a ferrous metal.

A saw cut was made through the strap portion that intersected the ends of the longest crack, indicated by arrow "W2" in figure 3. Figure 5 shows a photograph of the exposed face of the fracture. The fracture surface in the general area of the spot weld "W2" exhibited a brown tint consistent with an oxidized ferrous surface. The severely oxidized area extended between the outer and inner surface. Scanning electron microscope examination of the mating fracture face revealed a fatigue crack emanated from the outer surface of the strap. Fatigue crack propagation was in the general direction indicated by unmarked arrows in figure 5 and was through the thickness of the strap. The fatigue crack terminated in the areas indicated by a dashed line. The areas outside of the fatigue crack were on a slant plane and contained micro-void coalescence features typical of overstress separation. The length of the fatigue crack portion that intersected the inner surface measured approximately 0.07 inch.

Frank Zakar
Senior Metallurgist

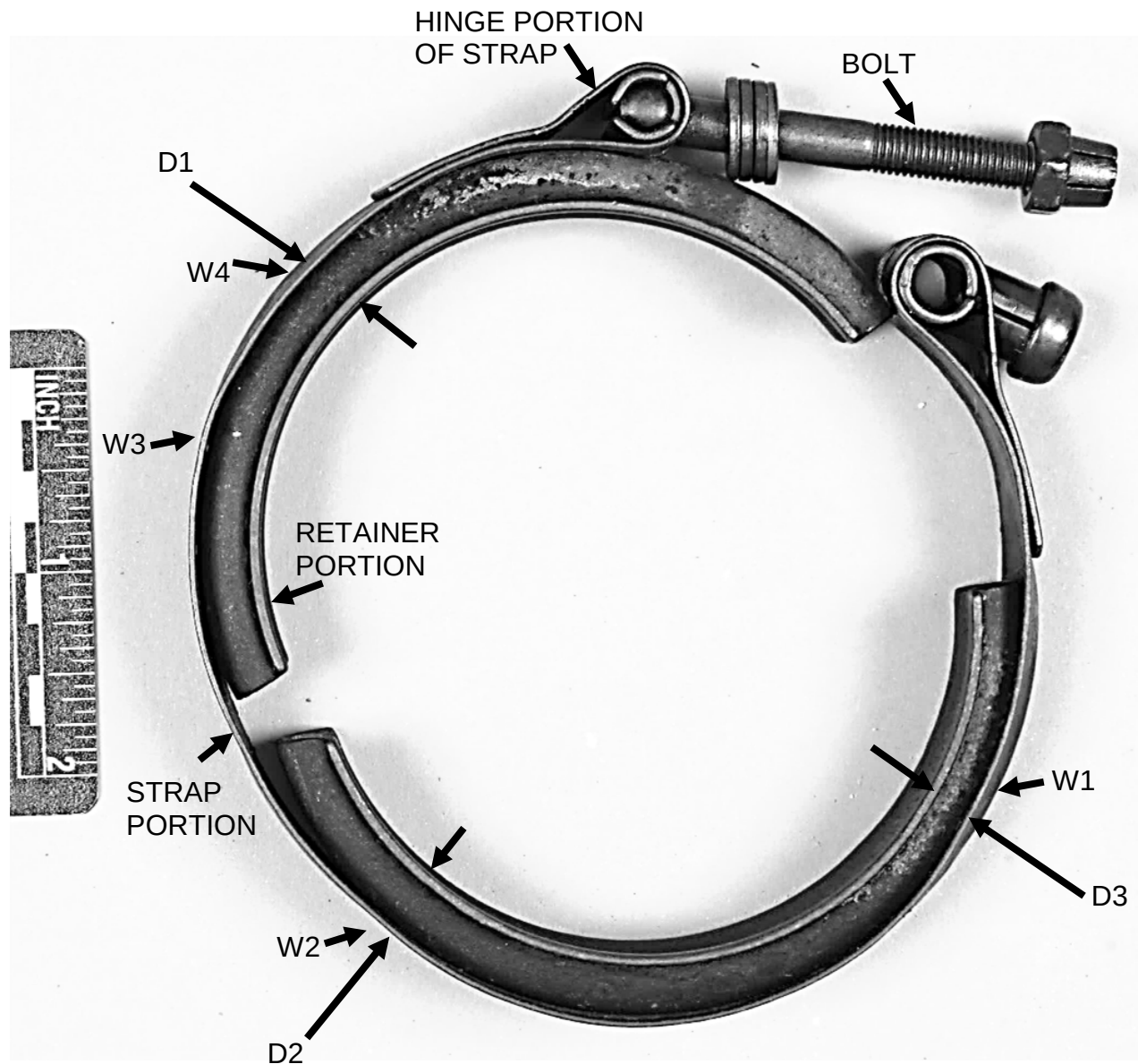


Figure 1. Photograph of the as-received turbo V-clamp assembly. The spot welds for the retainer are located approximately in the areas indicated by arrows "W1" through "W4". The distance between the inner surface of the clamp and the outer surface of the retainer was less in the areas between arrows "D1", "D2", and "D3", compared to other areas of the assembly. The distance between the inner surface of the clamp and the outer surface of the retainer in the deformed area between arrows "D3" measured approximately 0.16 inch. The distance between the inner surface of the clamp and the outer surface of the retainer in a non-deformed area measured approximately 0.24 inch, when measured with a caliper.

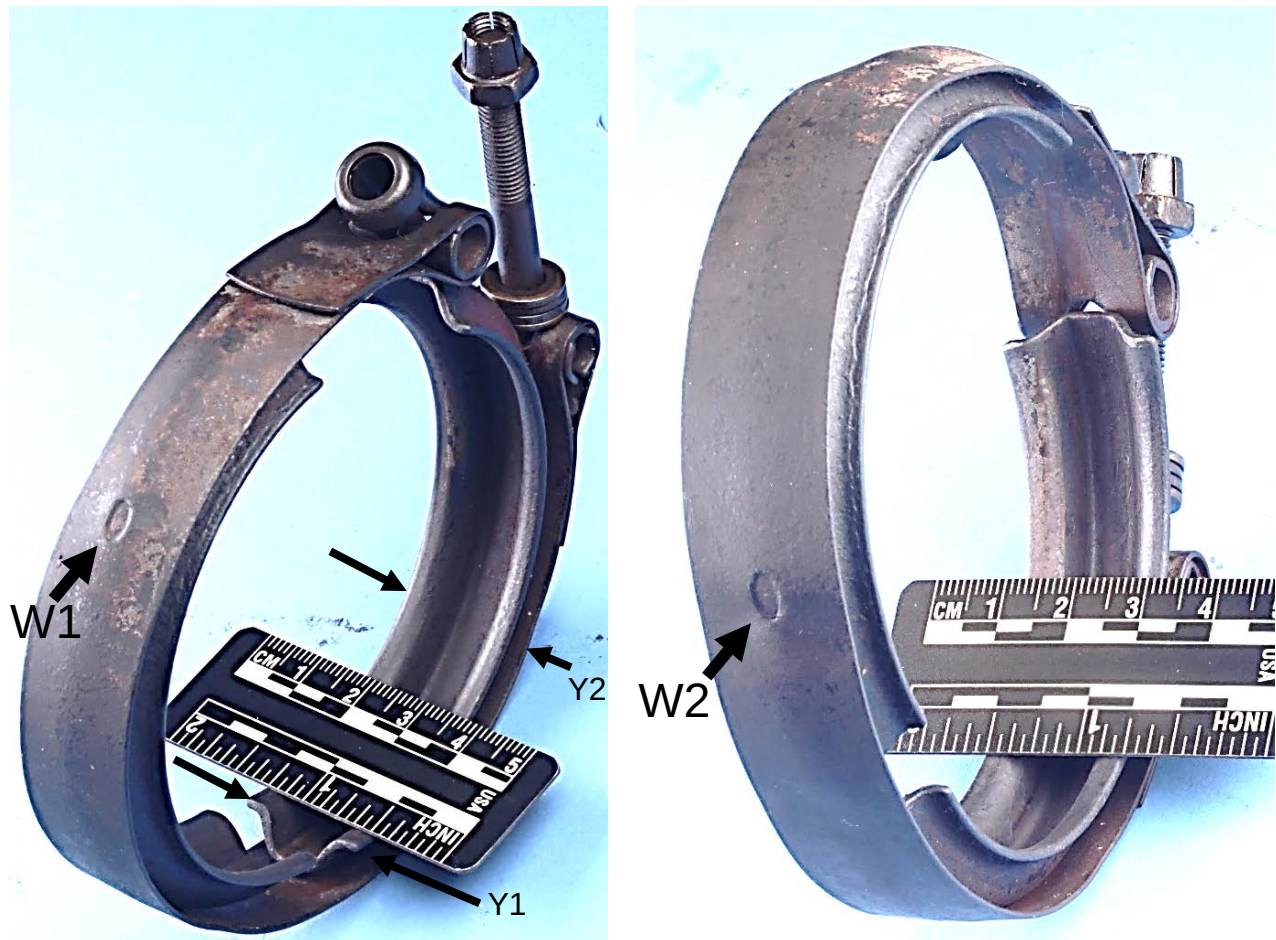


Figure 2. Photographs of the V-clamp assembly showing spot welds "W1" and "W2". The width of the retainer at one end in the area between arrows "Y1" measured approximately 0.82 inch. The width of the retainer in an area located midway between the ends ("Y2") measured approximately 0.76 inch.

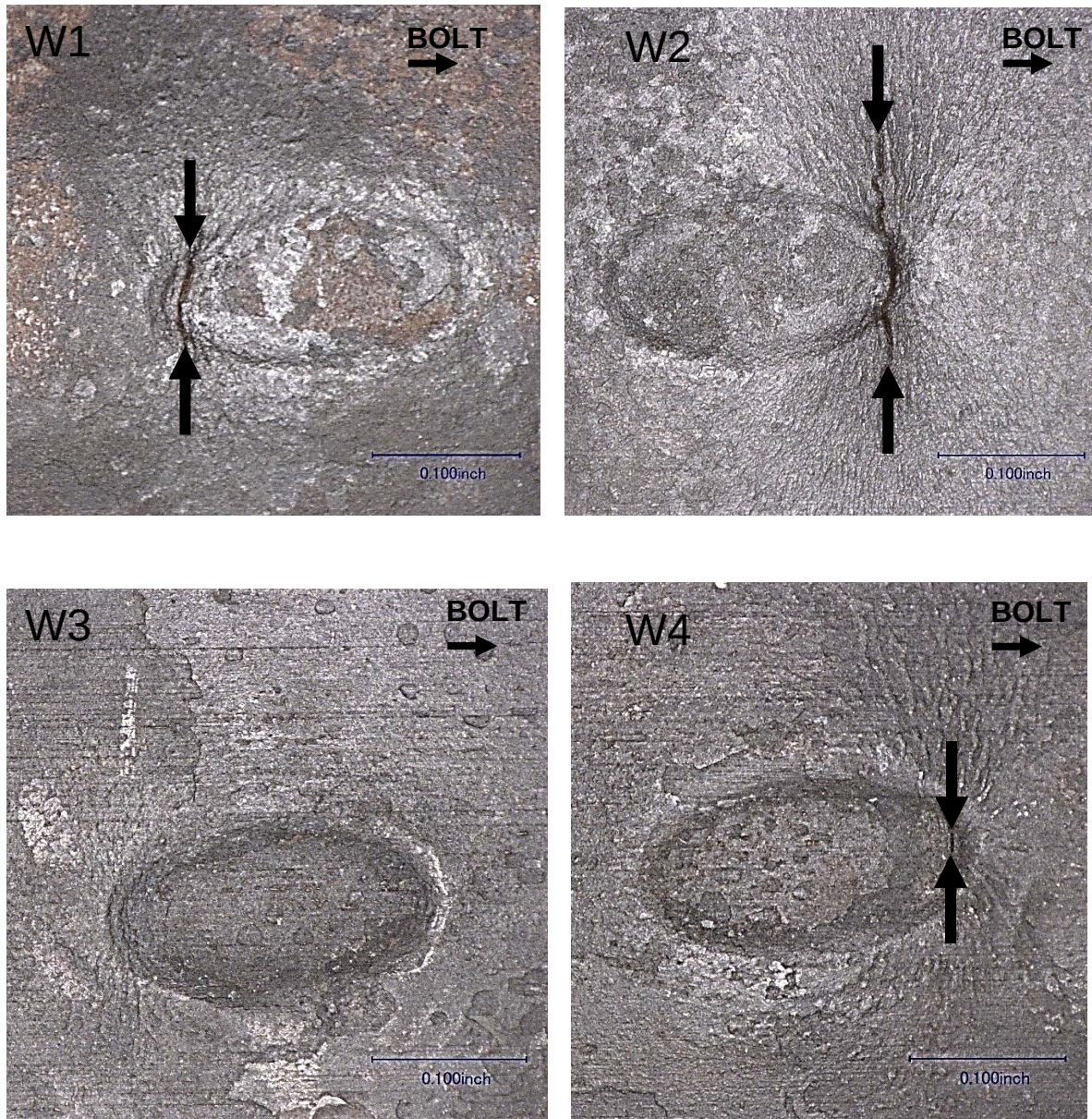


Figure 3. Photographs of outer face of the strap portion showing spot welds “W1” through “W4”. The spot welds appear oval. Spot welds “W1”, “W2”, and “W4” contained a crack at the outer edges in the area between arrows. Spot weld “W3” contained no evidence of a crack. The hinge portion of the strap that was attached to the bolt (for the latch mechanism) was located in the direction indicated by the arrow labelled “bolt”.

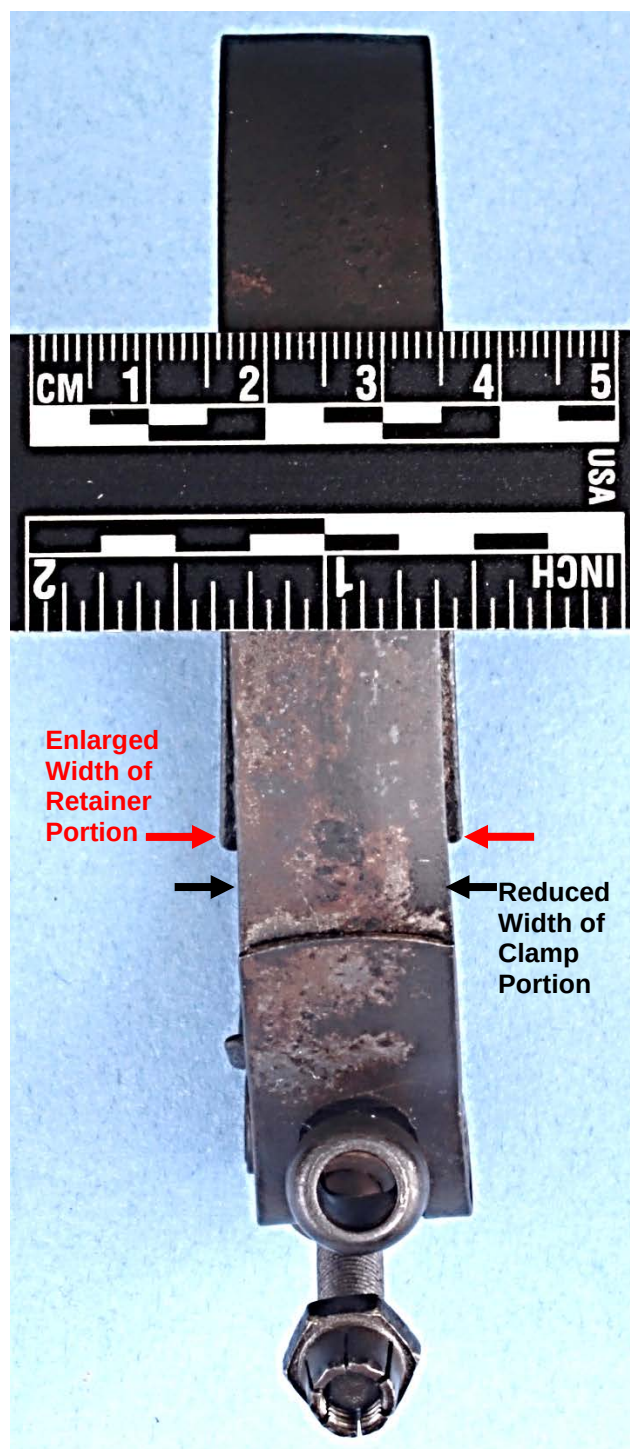


Figure 4. V-clamp assembly showing the reduced width of the clamp portion in the foreground and the enlarged width portion of the retainer in the background. The width of the clamp in the non-deformed area measured approximately 0.76 inch and in the reduced width area measured approximately 0.82 inch.

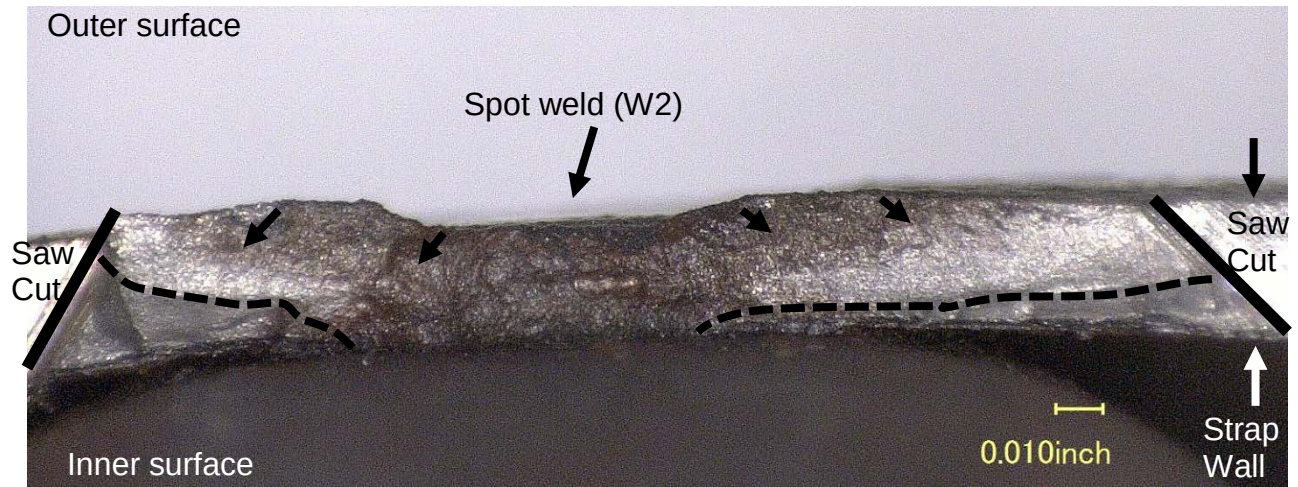


Figure 5. Photograph of a portion of the strap showing a fatigue crack that emanated from the outer surface of spot weld "W2". Fatigue crack propagation was in the general direction indicated by unmarked arrows and terminated in the general area indicated by a dashed line.