

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



HWY23MH017

MATERIALS LABORATORY

Factual Report 23-084

March 8, 2024

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A. ACCIDENT INFORMATION

Location: Teutopolis, IL
Date: September 29, 2023
Vehicle: 1978 Mississippi Tank Company MC331 cargo tank semitrailer
Investigator: Shawn Currie

B. COMPONENTS EXAMINED

1. Front head shell pieces cut from: 1978 Mississippi Tank Company MC331 cargo tank semitrailer.
2. Portion of trailer hitch with lunette ring.

C. EXAMINATION PARTICIPANTS

Specialist Michael Budinski
National Transportation Safety Board
Washington, DC

Engineering Technician Edward Komarnicki
National Transportation Safety Board
Washington, DC

D. DETAILS OF THE EXAMINATION

The as-received evidence is shown in Figure 1. Three pieces were torch-cut from the front head of MC331 cargo tank semitrailer. The locations of the three front head shell pieces are shown in Figure 2 and are arbitrarily labeled A, B and C. A sketch in Figure 3 shows the location of butt welds used to join the segments and cap for the front head. The approximate locations of the three head shell pieces are located on the sketch to show the approximate location of the welds on the cut pieces. In this sketch, the segment pieces are arbitrary numbered for documentation purposes.

Figure 4 shows the external side of head shell piece A. A perforation approximately 6.3 inch wide and 2 inch long is approximately located in the geometric center of the piece. Remnants of a temporary tape patch are present around the perforation. The mechanical deformation associated with the perforation reveals that the shell piece was perforated from the outside towards the inside of the tank. In Figure 5, yellow dashed lines overlaid on the image show the approximate locations of the segment and cap butt welds.

Closer views of the perforation in shell piece A are shown in Figures 6-8. The perforation occurred close to the meeting point of the welds for segments 1, 6, and the cap. Due to the mechanical deformation from the perforation, a crack developed on the external surface along the crown of the butt weld deposit between segments 1 and 6 (see Figure 8 for close detail).

Images showing the inside surface of shell piece A are shown in Figures 9-11. In Figure 10, the approximate locations of the butt welds are projected onto the image. The perforation coincides with the meeting of the segment 1 to segment 6 weld at the cap. The image in Figure 11 shows close details of the mechanical deformation associated with the perforation. The shell piece is petaled inward around the perforation, consistent with inward perforation from an external source.

To simulate the perforation event, the trailer hitch with lunette ring was placed in close proximity to the perforation as shown in Figures 12-14. The size and shape of the perforation is consistent partial penetration by the lunette ring (about 5.8 inch wide x 1.5 inch thick). The dimensions of the perforation were consistent with the dimensions and shape of (e.g. thickness and outside diameter) of the lunette ring. During the fit-up of the lunette ring in the head shell perforation, the back side of the trailer hitch was photographed to document witness marks. Figure 15 shows the back side of the trailer hitch mounting plate and the front (exterior surface) of head shell piece A

Figures 16-18 show views of the internal side of shell piece A with the lunette ring placed in close proximity to the perforation. The size and shape of the perforation is consistent partial penetration by the lunette ring.

Head shell pieces labeled B and C were not examined.

Submitted by:

Michael Budinski
Chief, Materials Laboratory

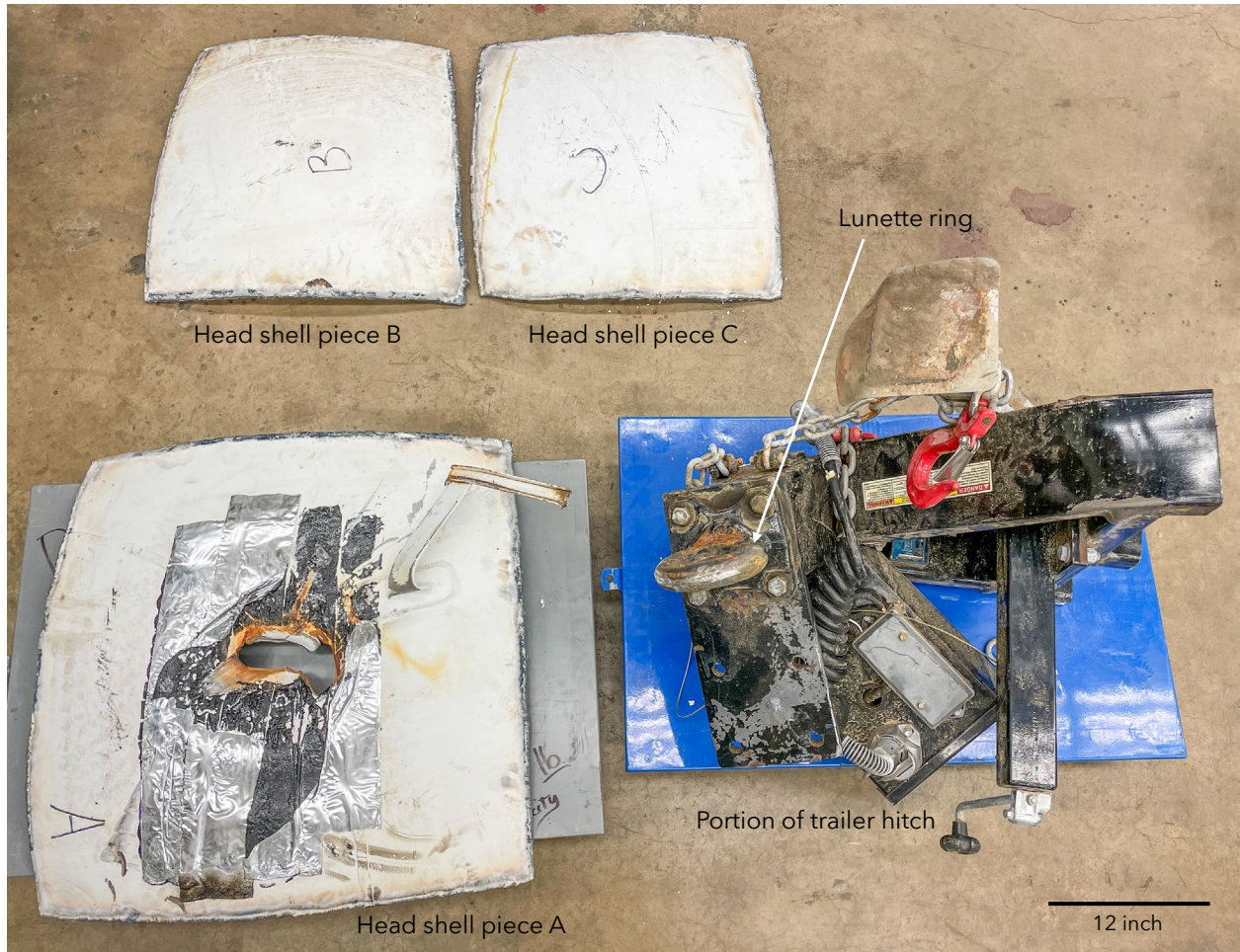
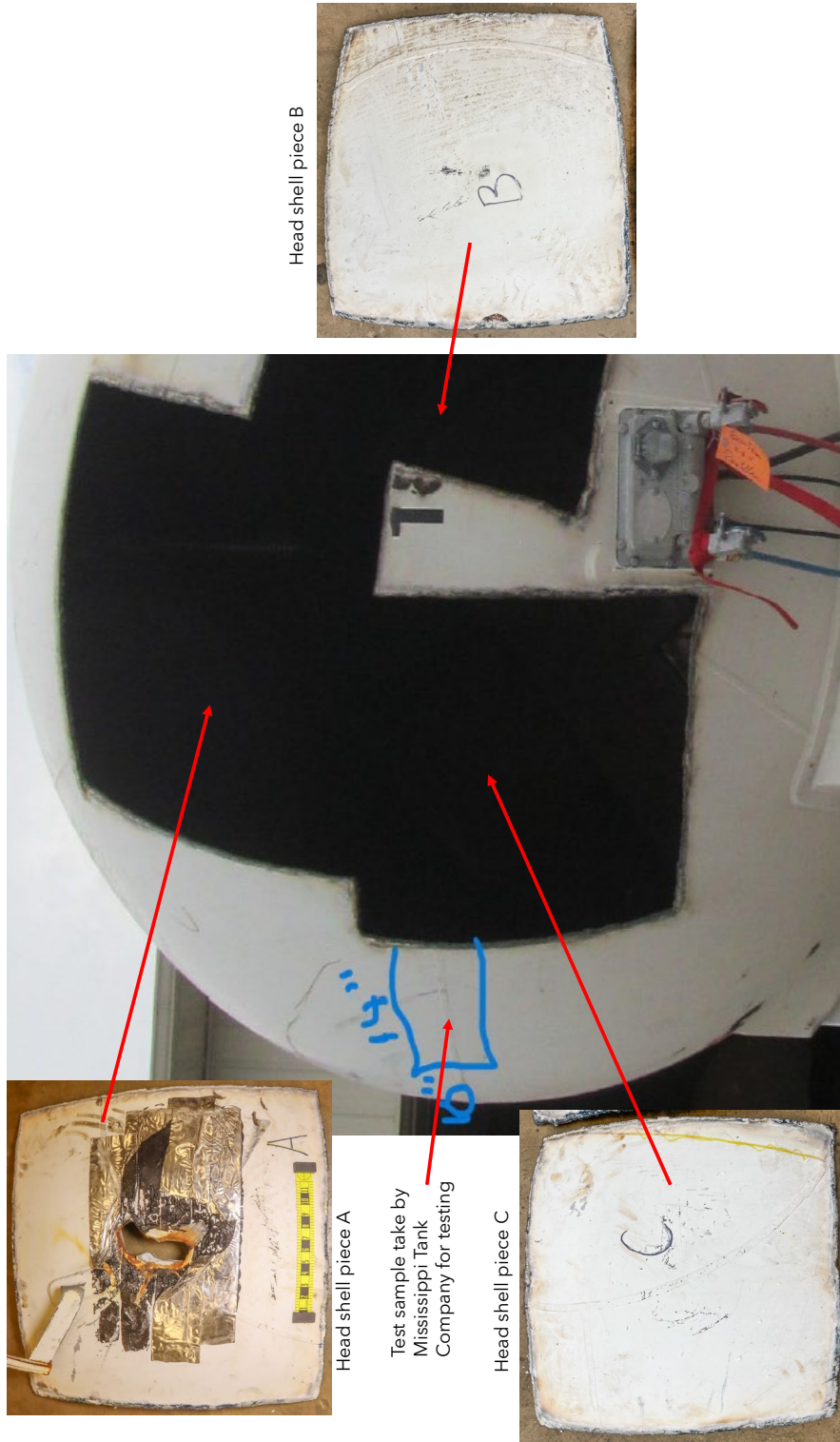


Figure 1. As-received evidence: three head shell pieces labelled A, B, and C; portion of trailer hitch with lunette ring.



Head shell piece B

Head shell piece A

Test sample take by
Mississippi Tank
Company for testing

Head shell piece C

Figure 2. Image of the front of the cargo tank semitrailer showing the location of head shell pieces A, B, and C.

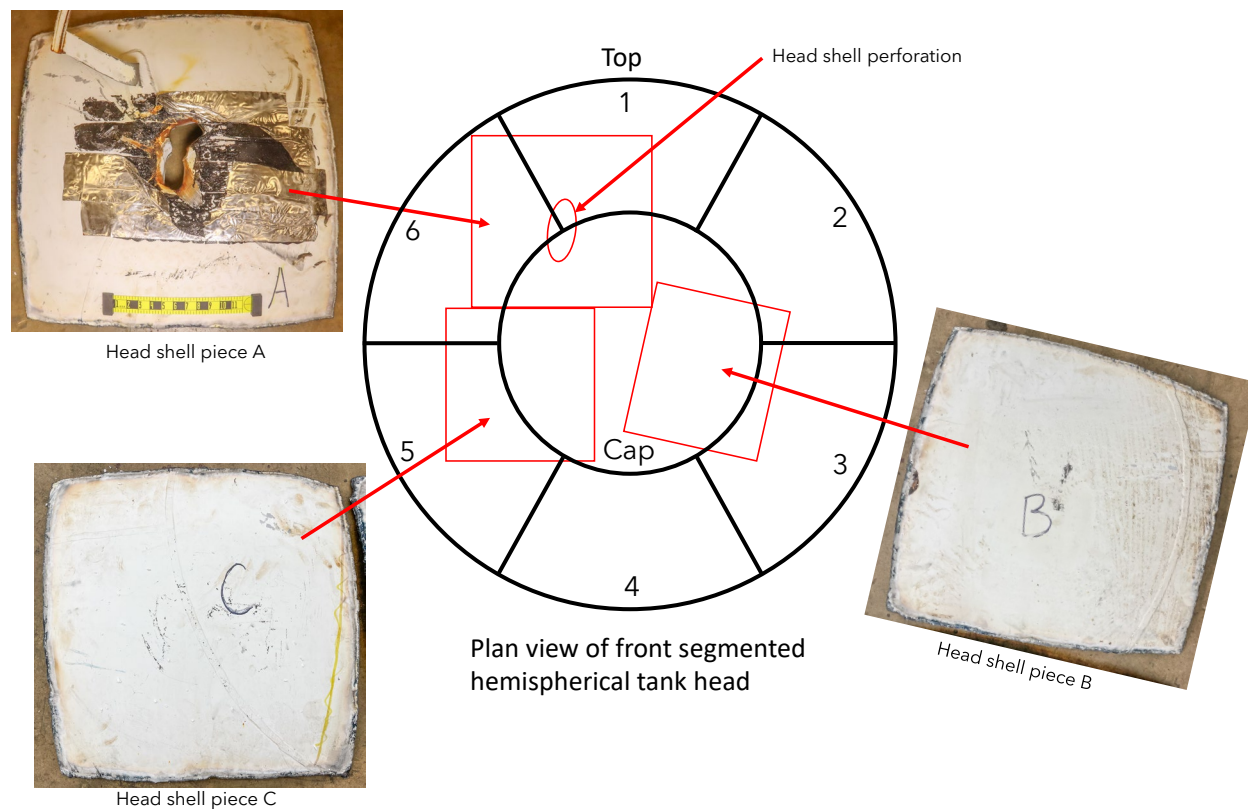


Figure 3. Plan view of the front of the cargo tank semitrailer showing the location of the butt-welded panels. The panels have been arbitrarily numbered for reference purposes. The locations of the removed head shell pieces A, B and C are also shown for reference (external side shown). The location of the perforation in the head is shown; it occurred where the segment 1-6 butt weld met the cap butt weld.



Figure 4. View of the external side of head shell piece A, which contains a perforation. The upward direction of the shell piece is labelled. Remnants of a foil tape are present around the perforation.

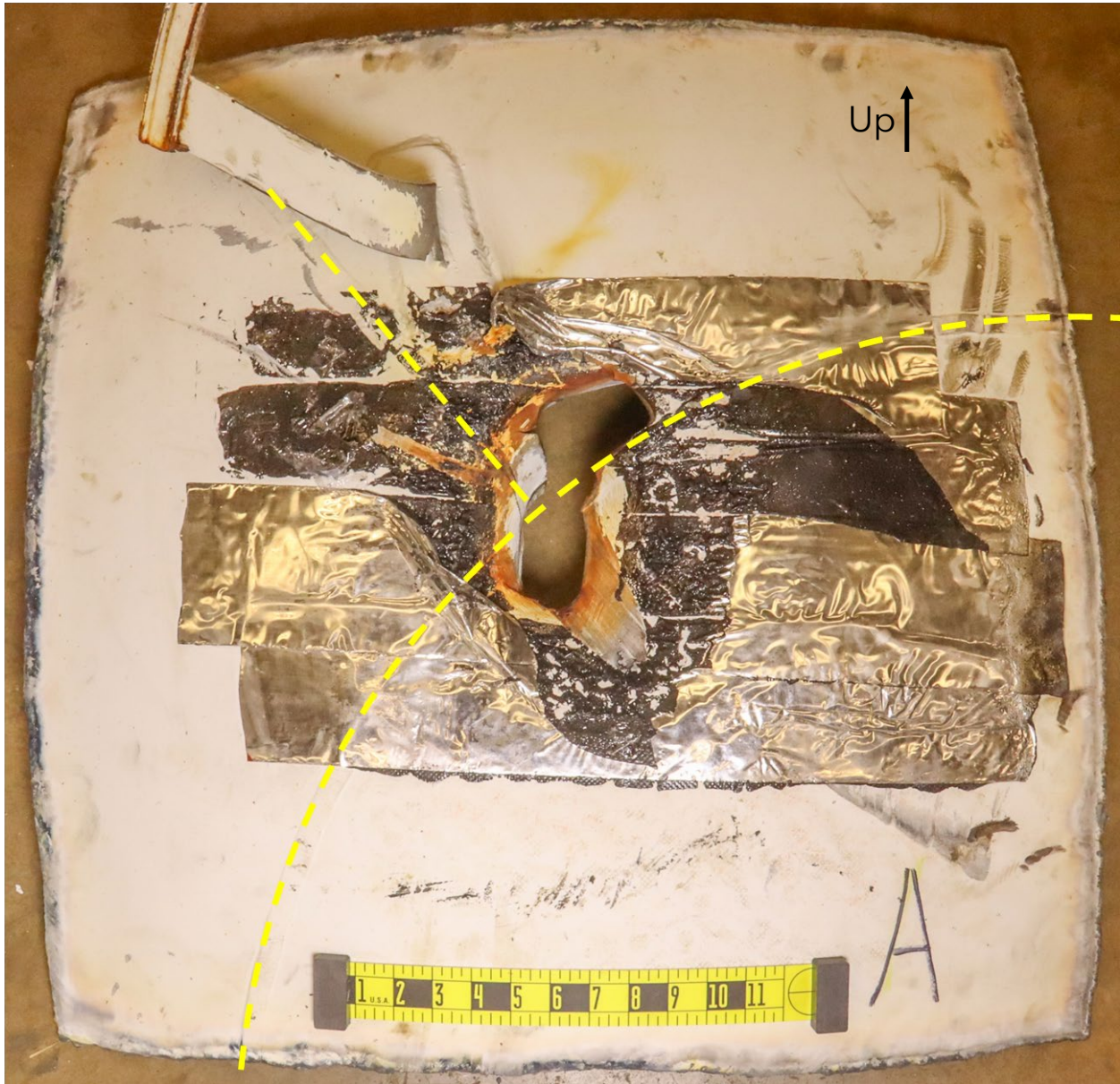


Figure 5. View of the external side of head shell piece A, which contains the perforation. The dashed yellow lines show the approximate paths of the butt weld deposits. Segments 1, 6, and the cap are identified. The perforation occurred where the segment 1-6 and cap butt welds meet.



Figure 6. Closer view of the external side of head shell piece A, which contains a perforation.



Figure 7. Close and detailed view of the external side of the perforation in head shell piece A (view a). Views b and c show the butt weld deposits in relation to the perforation.

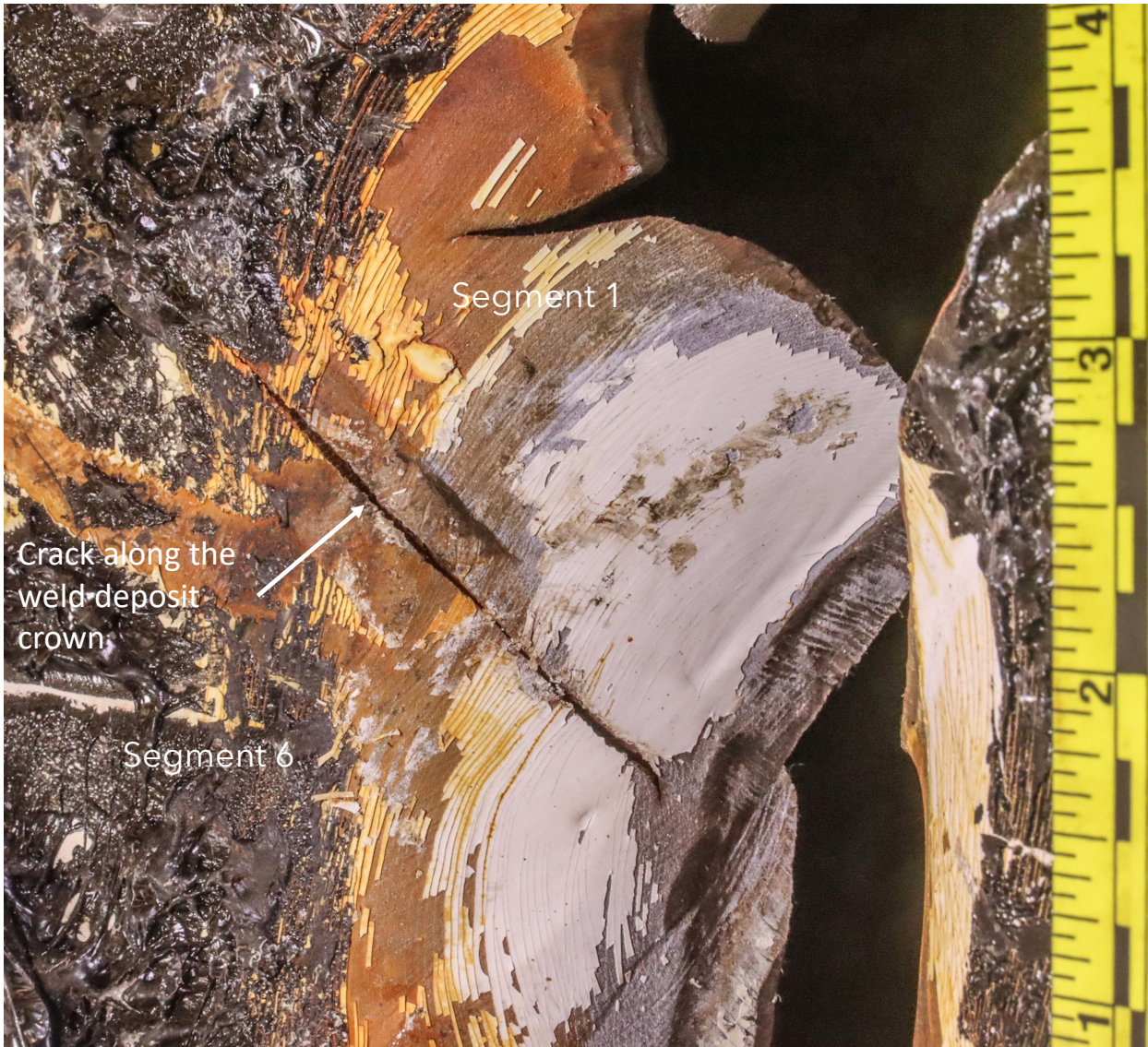


Figure 8. Close view of the butt weld between segment 1 and 6 revealing a crack in the crown of the weld deposit in the deformed area of the perforation.

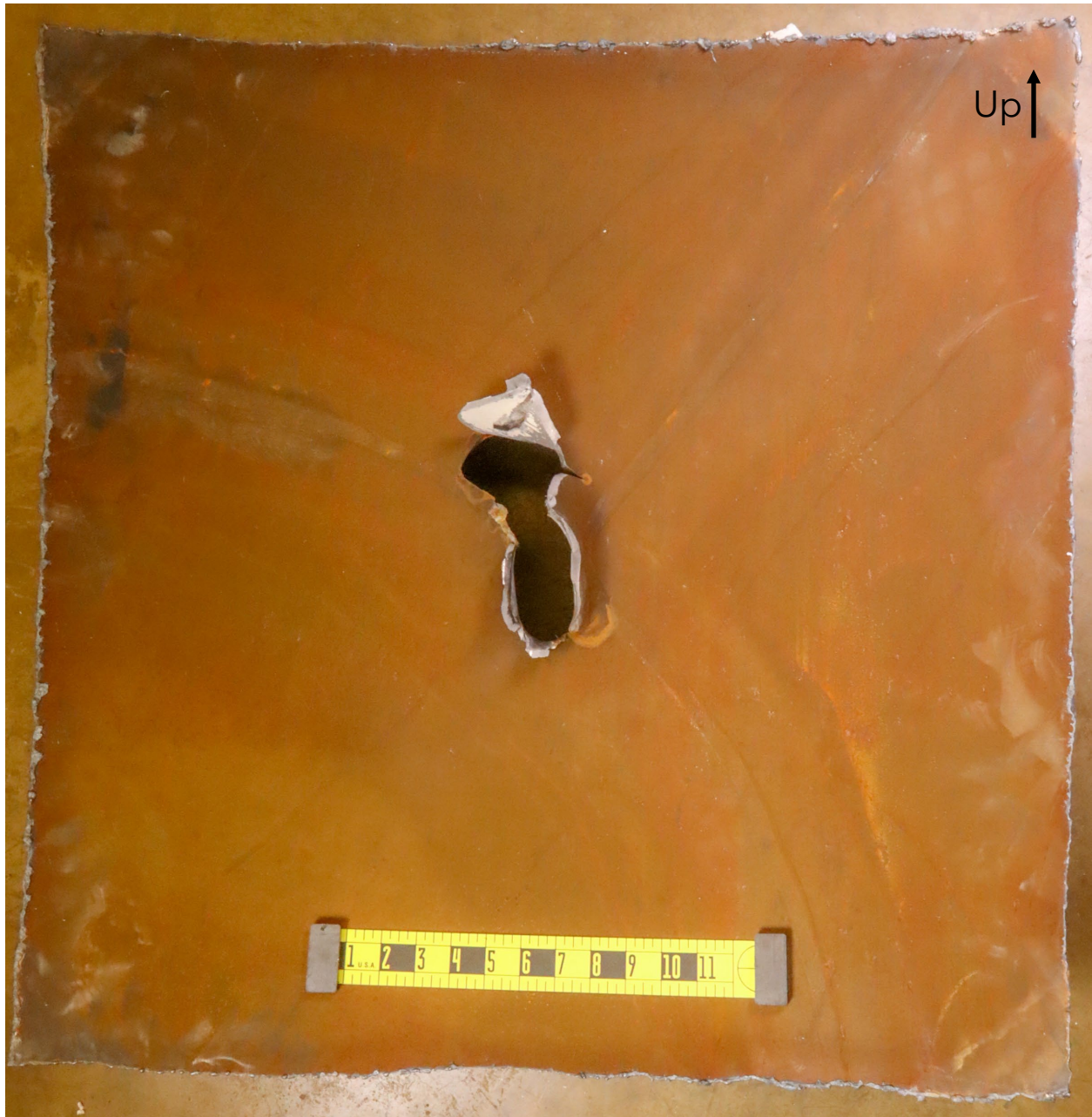


Figure 9. View of the internal surface of the front head shell piece A revealing a perforation with deformed material petaled inward from the exterior. The internal shell surface, which is untreated steel, exhibited a uniformly-colored layer of ferrous corrosion product.

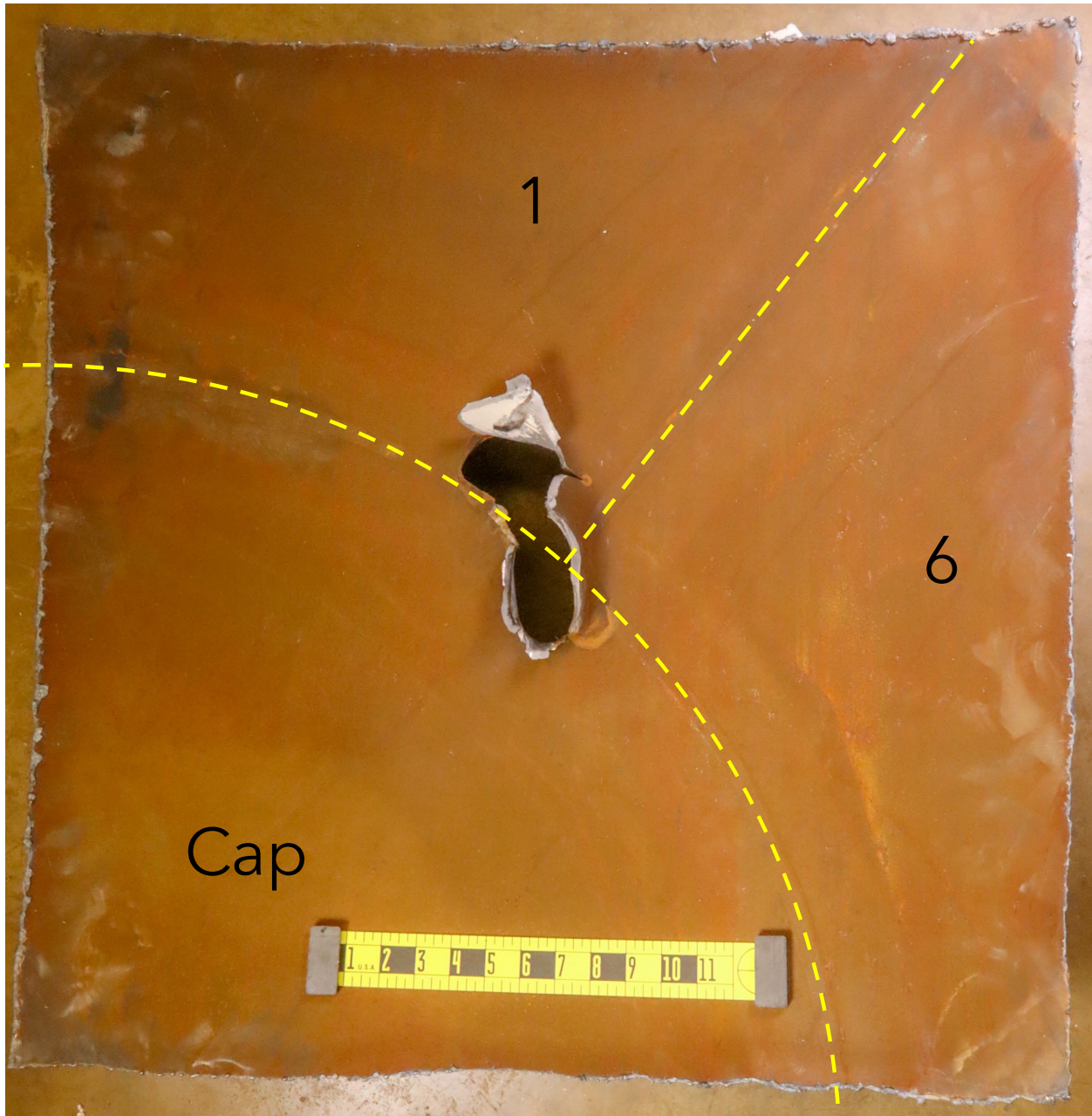


Figure 10. Similar view to Figure 9 with yellow dashed lines showing the approximate location of the butt weld deposits joining segments 1, 6, and the cap.



Figure 11. Close view of the internal surface of front head shell piece A revealing a perforation with deformed material petaled inward from the exterior.



Figure 12. View of the perforation in the exterior side of the front head shell piece A with the trail hitch lunette ring placed close to the perforation.



Figure 13. Closer view of the perforation in the exterior side of the front head shell piece with the trail hitch lunette ring placed close to the perforation.



Figure 14. Closer view of the perforation in the exterior side of the front head shell piece with the trail hitch lunette ring placed close to the perforation.

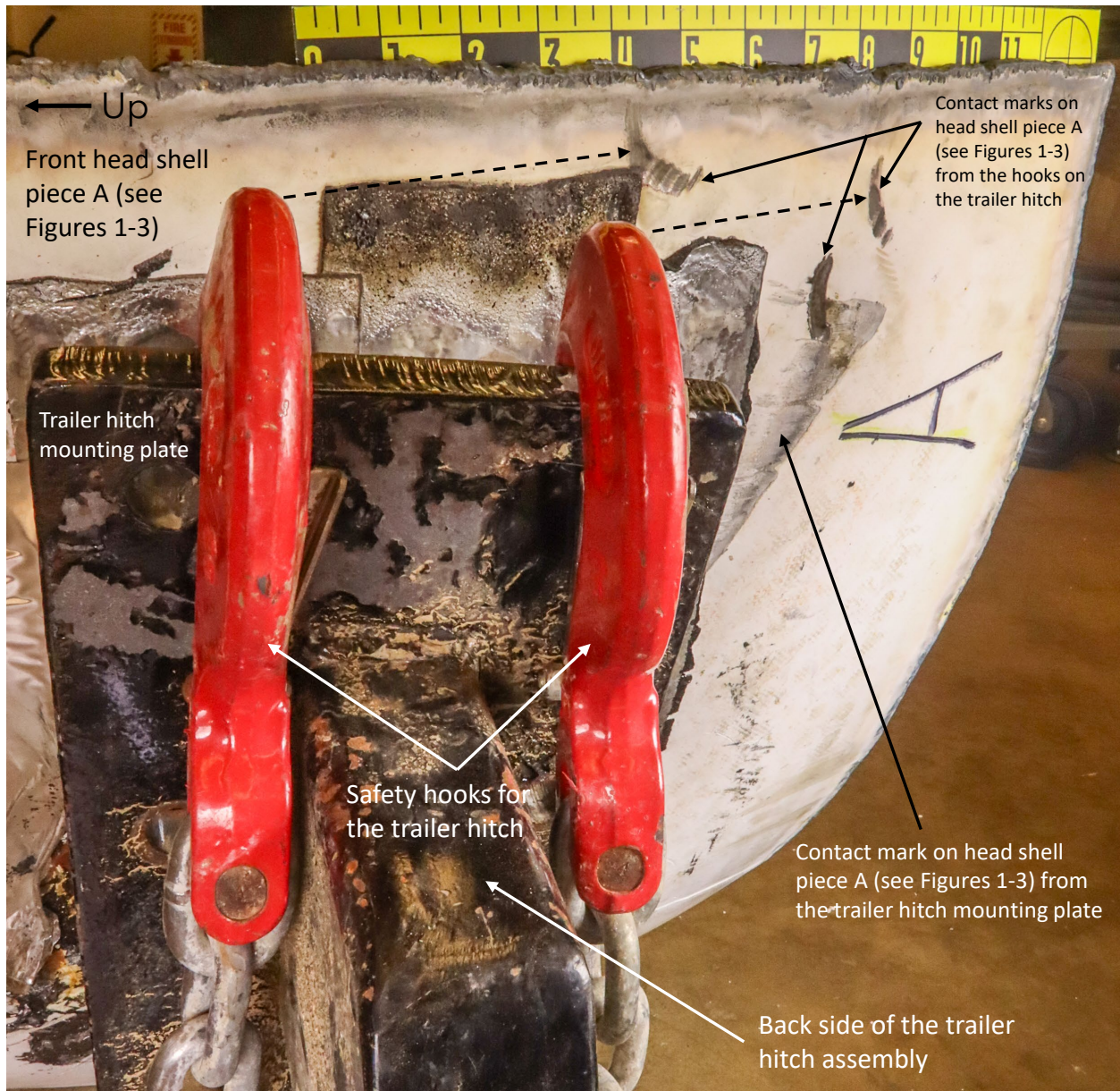


Figure 15 View of the exterior side of the front head shell piece with the trail hitch placed in close proximity. Several contact or witness marks are identified consistent with the trailer hitch mounting plate and hooks contacting the exterior side of the front head shell.

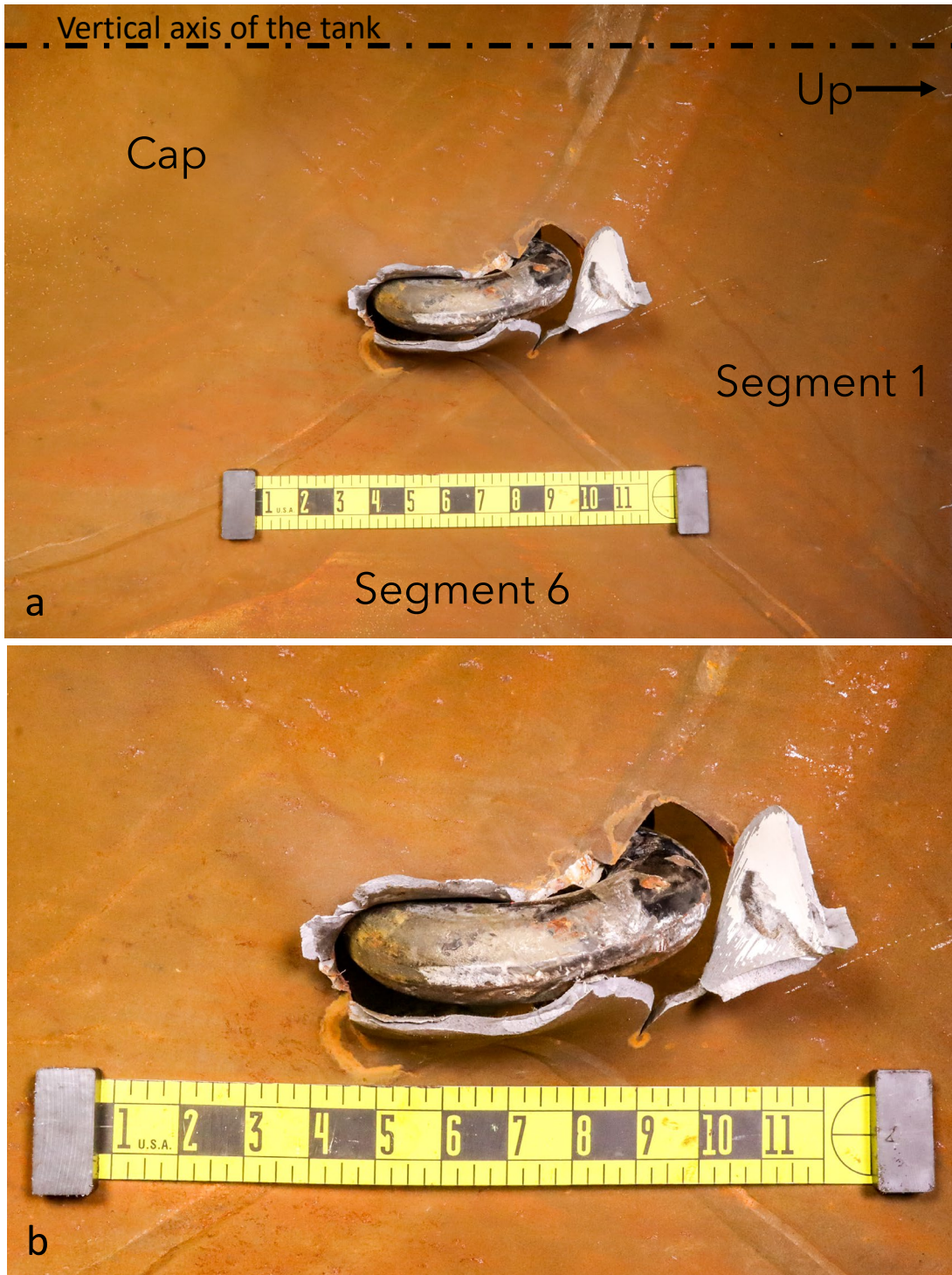


Figure 16. Views of the internal surface of front head shell piece A with the trailer hitch lunette ring in close proximity to the perforation. Deformed material petaled inward from the exterior. View a shows the location of segment 1, 6, and the cap.



Figure 17. Oblique side view of the internal surface of front head shell piece A with the trailer hitch lunette ring in close proximity to the perforation. Deformed material petaled inward from the exterior.



Figure 18. Oblique top-down view of the internal surface of front head shell piece A with the trailer hitch lunette ring in close proximity to the perforation. Deformed material petaled inward from the exterior.