

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR23FA185

MATERIALS LABORATORY

Factual Report 24-090

March 4, 2025

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A. ACCIDENT INFORMATION

Location: San Clemente Island, California
Date: May 10, 2023
Vehicle: Gates Lear Jet 36A, N56PA
Investigator: Daniel Baker

B. COMPONENTS EXAMINED

Portions of the fuselage fuel tank aft bulkhead (Figure 1). Fuel motive flow and hydraulic fluid return bulkhead fittings from left side aft engine mount carry through area (Figure 2).

C. EXAMINATION PARTICIPANTS

Group Chair Joseph Panagiotou
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Washington, DC

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D. DETAILS OF THE EXAMINATION

The parts examined and described in this report had been submerged for a period of approximately 6 months in a corrosive saltwater environment while in the Pacific Ocean off the coast of San Clemente Island.

The aft bulkhead of the fuselage fuel tank was fractured into 3 pieces (Figures 3, 4, 5). The right side remained intact from top to bottom and the left side was fractured into approximately two equal portions. The aft facing side of the bulkhead would have been facing the interior of the aft equipment bay. This side of the bulkhead was painted with a green corrosion resistant primer. The forward face of the bulkhead was also painted with a green corrosion resistant primer. The forward face of the bulkhead panel would have been in direct contact with the rubber fuel bladder of the fuselage fuel tank.

The aft face of the fuselage fuel tank bulkhead exhibited overall thermal discoloration of the primer and soot staining. There were regions where the primer was clean and bright with no evidence of thermal discoloration. Those regions corresponded to "protected surfaces" which would have not been exposed to the interior of the aft equipment bay while the aircraft's structure was intact. Typically,

these protected regions correspond to seams and joints that would have been covered by structural elements such as doublers. These clean protected surfaces surrounded by thermally discolored or sooted surfaces are consistent with thermal damage that was sustained in flight before impact.

The aft-facing side of the upper portion of the left side of the fuselage fuel tank aft bulkhead exhibited a region of damage that was different than what was observed throughout the rest of the bulkhead (Figure 6). This region of damage was mostly devoid of any remaining charred primer paint and the aluminum substrate was eroded. In some areas within this region, the erosion was all the way through the thickness of the aluminum bulkhead panel. Other areas throughout the entire fuselage fuel tank aft bulkhead that exhibited charred, or missing paint did not exhibit the erosion. Additionally, the eroded area exhibited points of greenish coloration. A sample (Figure 7) was cut out of this area and examined using Energy Dispersive Spectroscopy (EDS). The EDS examination revealed copper oxides in the areas with the greenish coloration. The forward-facing side of this upper left-hand portion of the fuselage fuel tank aft bulkhead had some of the rubber fuel tank liner still attached (Figure 8). The rubber liner corresponding to the eroded area had shrunk and receded and could no longer overlap with the eroded area. The eroded area on the forward-facing side of this panel had more charred primer paint still adhering to the panel than the corresponding area on the aft facing side of the panel. Additionally, the gradient between charred primer and undamaged primer in this area was very sharp consistent with a focused heat source.

The aft-facing side of the lower portion of the left side fuselage fuel tank aft bulkhead exhibited an area along its upper outboard edge with similar characteristics as those observed in the eroded area of the upper portion of the bulkhead on the left side (Figure 5). This area of erosion and focused thermal damage was continuous across both portions of the bulkhead on the left side. Below this area the thermal damage became more diffuse. On the forward-facing side of this portion of the lower left bulkhead, the primer paint was less thermally discolored than on the aft-facing side.

The right-side portion of the fuselage fuel tank aft bulkhead remained intact as one piece (Figure 3). Overall, on the aft-facing side the thermal discoloration was mostly uniform and diffuse. This side did not exhibit areas of sharp demarcation between thermally damaged and non-damaged areas. The upper half of this portion had some green colored debris adhering to the surface. This green debris resembled electrical wire fragments (Figure 9). The forward-facing side of this right-side portion of the fuselage fuel tank bulkhead exhibited fairly uniform and diffuse thermal discoloration of the primer.

The remaining rubber fuel bladder that was attached to the portions of the fuselage fuel tank aft bulkhead was removed. The portions of the bulkhead were then aligned in position with respect to each other to get an overall view of the bulkhead

in its entirety (Figures 10, 11). This overall view revealed that on the aft-facing side the bulkhead exhibited a focused region of thermal damage extending from the 7 o'clock to the 10 o'clock position along the outboard edge of the bulkhead. While the rest of this aft facing side exhibited thermal damage that was more diffuse and less severe. The forward-facing side of the bulkhead (now with the rubble bladder removed) exhibited overall more thermal discoloration on the right-side half than on the left side with the exception of the focused region of thermal damage on the left side.

The motive flow fuel fitting (Figure 12) and the hydraulic fluid return fitting (Figure 13) were bulkhead type fittings that penetrated the fuselage near the aft left engine mount. These fittings were made out of steel and were located a couple inches from each other. Both of the fittings exhibited red rust colored corrosion. On the outboard side, both of these fittings had stainless steel nuts attached and tubing with fire resistant sleeves (Figure 2). No thermal damage was observed on the outboard nuts and attached portions of tubing. On the inboard side, the motive flow fuel fitting was missing the nut and tubing. The missing nut and tubing on the inboard side would have been made out of aluminum. Examination of the threads on the inboard side of the motive flow fuel fitting using a stereo microscope did not reveal evidence of thread stripping. On the inboard side, the hydraulic fluid return fitting still had the nut attached but was missing the tubing. The nut and tubing for this fitting were also constructed of aluminum. After removal of the nut, examination of the threads did not reveal any anomalies. Comparison between the two fittings (motive flow fuel, hydraulic fluid return) did not reveal any physical differences to explain why one remained with the nut attached and the other did not (Figure 14).

Submitted by:
Joseph Panagiotou
Fire Protection Engineer

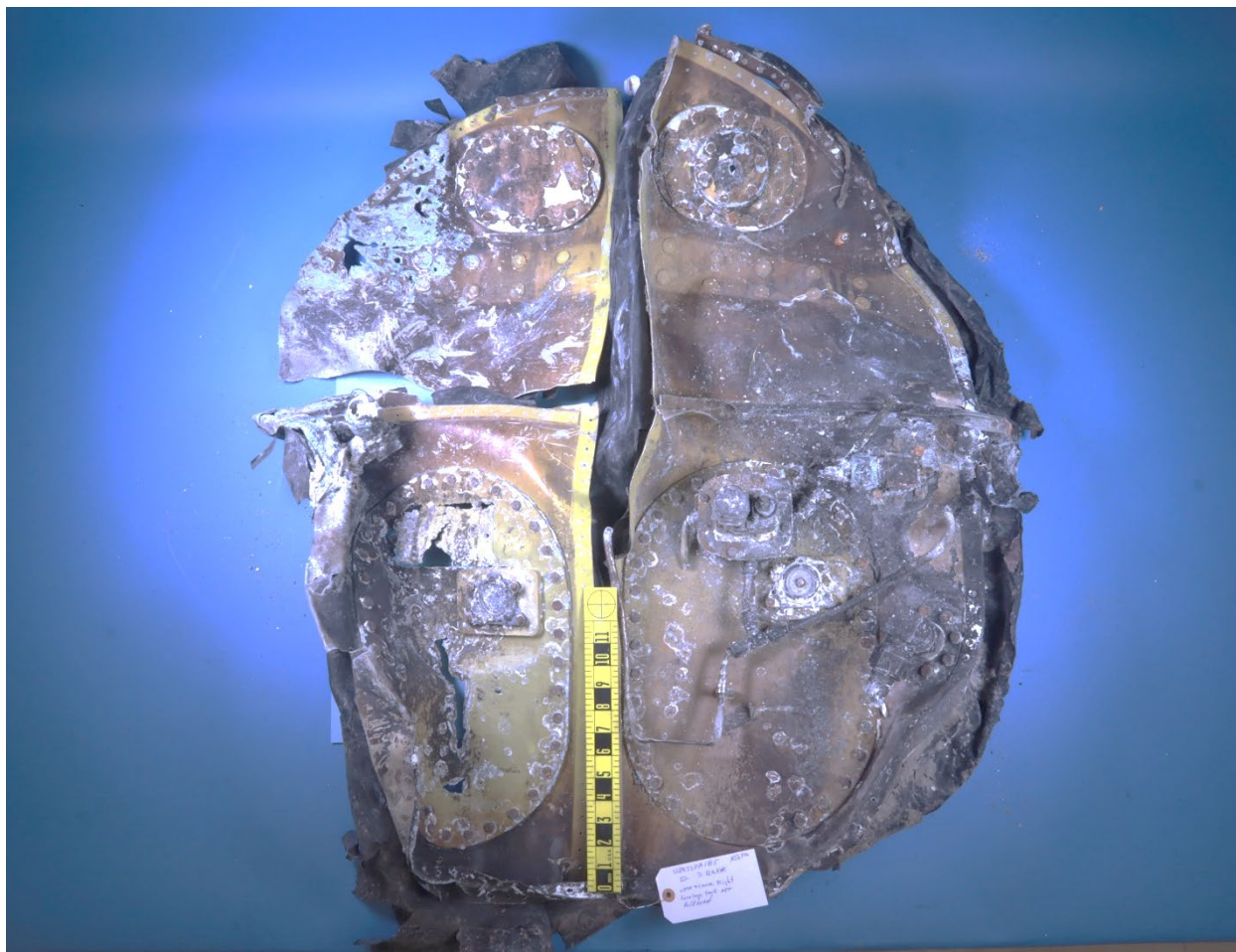


Figure 1. Portions of fuselage fuel cell aft bulkhead (as Received)



Figure 2. Motive flow fuel line with fittings (Top) Hydraulic fluid return line with fittings (Bottom) as received.

FWD side



AFT side



Figure 3. Right side portion of the fuselage fuel tank aft bulkhead.

AFT side

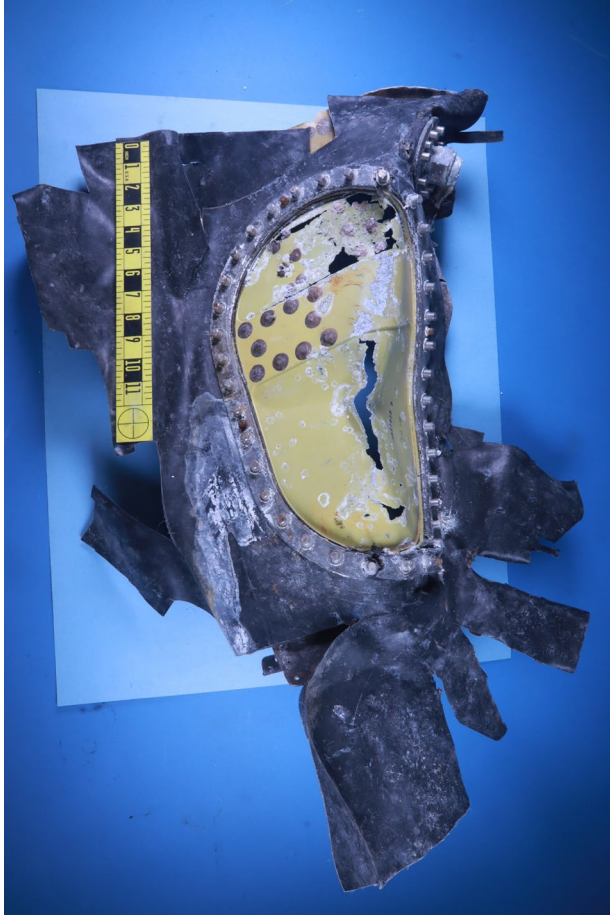


FWD side



Figure 4. Left side top portion of the fuselage fuel tank aft bulkhead.

FWD side



AFT side



Figure 5. Left side bottom portion of the fuselage fuel tank aft bulkhead.

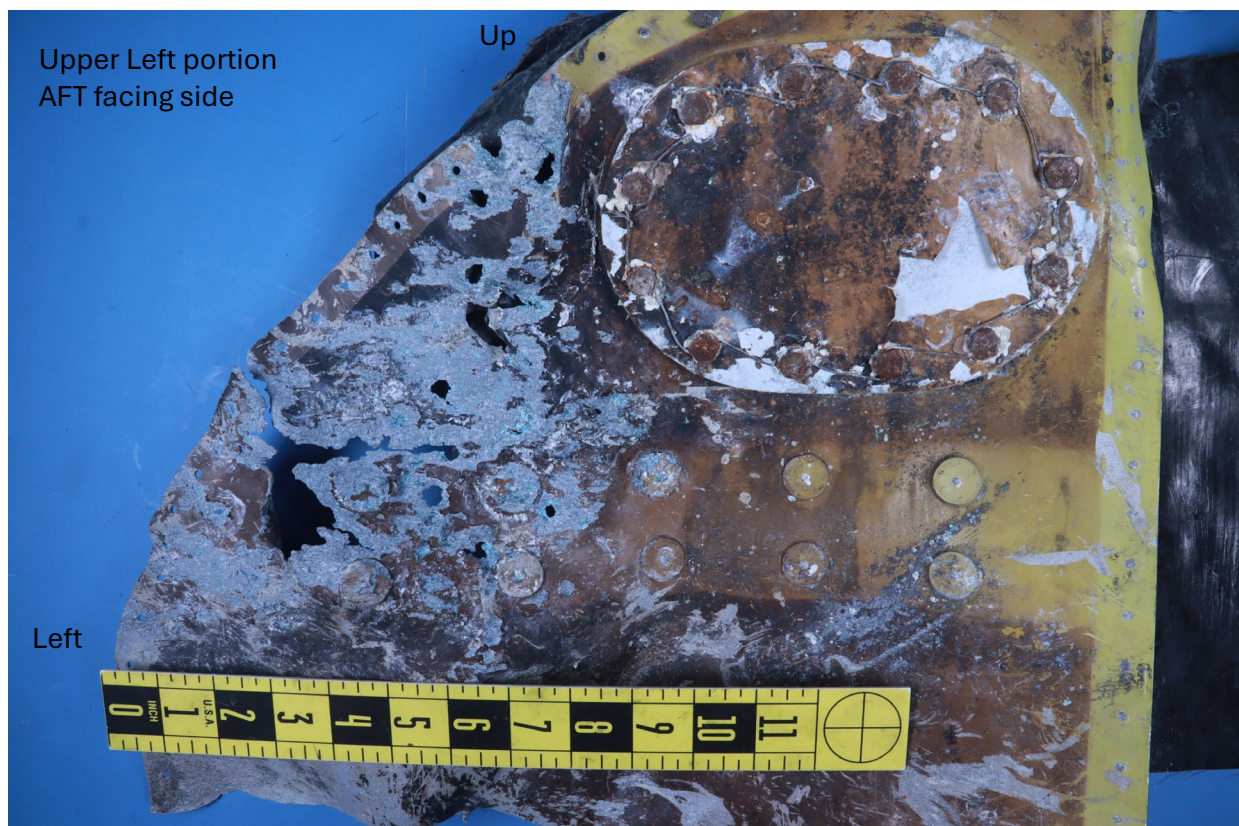


Figure 6. Upper left portion of the fuselage fuel tank aft bulkhead exhibiting a region of erosion of the aluminum panel.

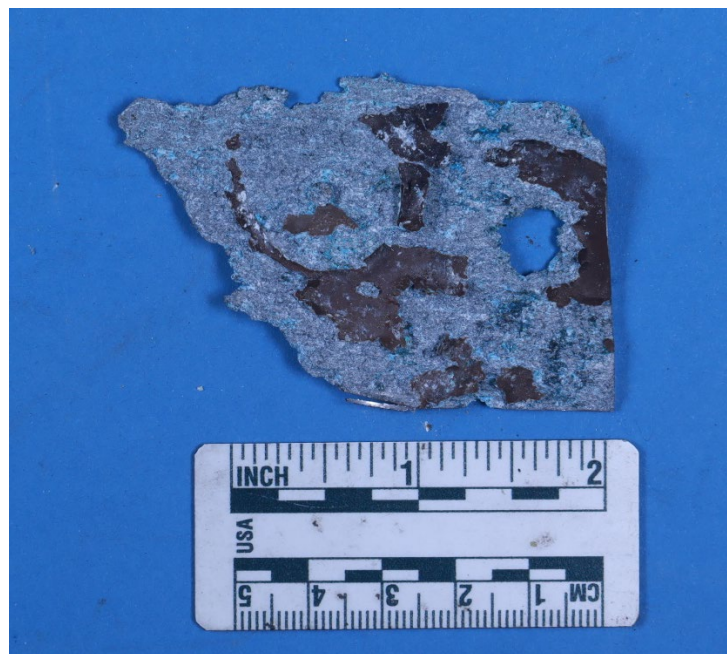


Figure 7. Sample removed from the erosion region of the upper left had portion of the fuselage fuel tank aft bulkhead.

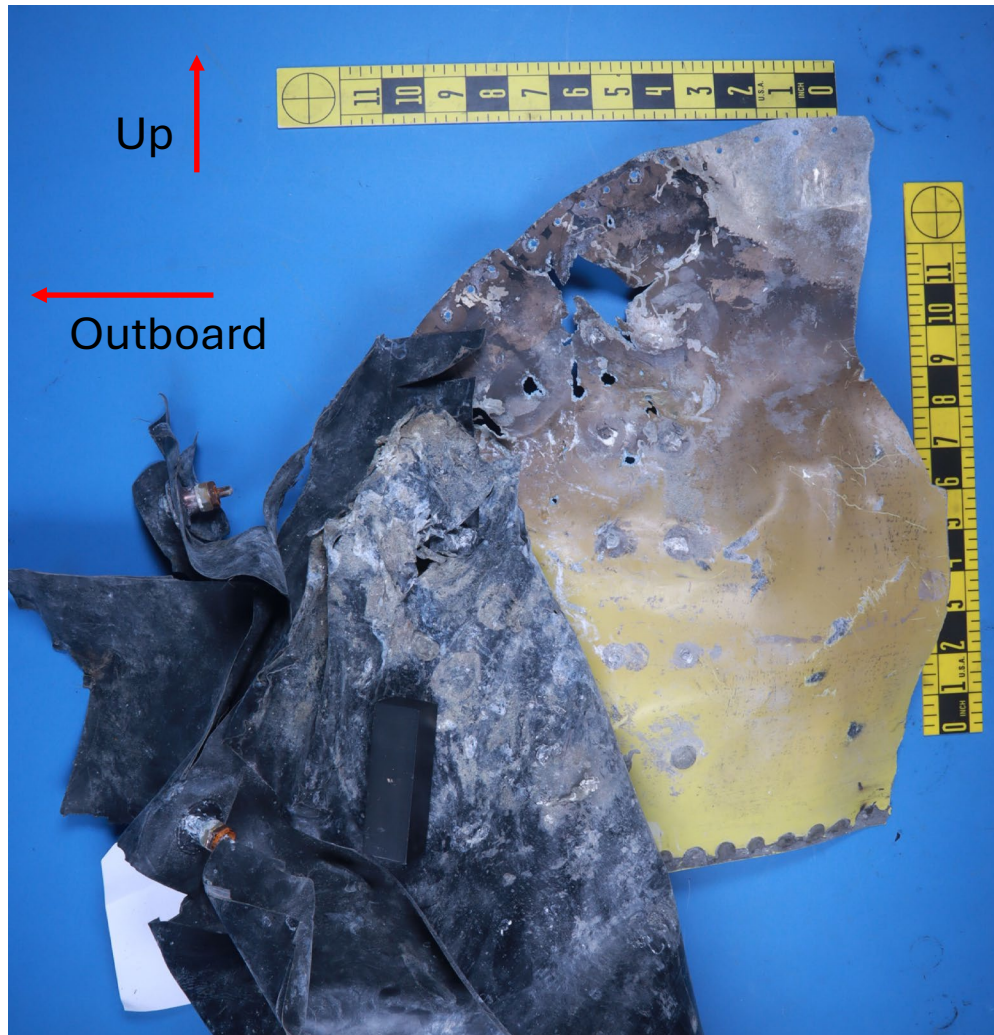


Figure 8. Forward-facing side of the upper left-hand portion of the fuselage fuel tank aft bulkhead.



Figure 9. Green debris adhering to the aft-facing surface of the right-side portion of the fuselage fuel tank aft bulkhead.



Figure 10. Aft-facing side of the fuselage fuel tank aft bulkhead.



Figure 11. Forward-facing side of the fuselage fuel tank aft bulkhead with the rubber fuel tank liner removed.

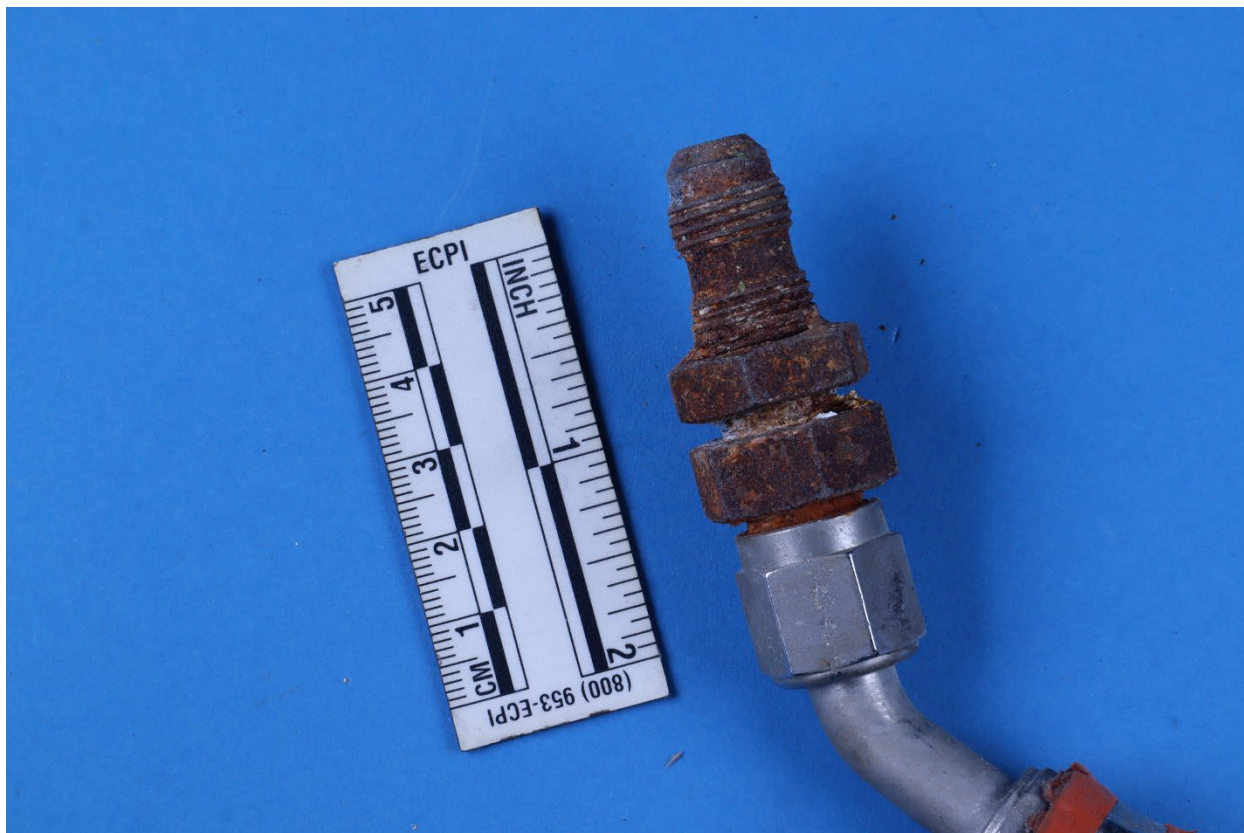


Figure 12. Motive flow fuel line bulkhead fitting.



Figure 13. Hydraulic fluid return line bulkhead fitting.



Figure 14. Hydraulic fluid return (top) and motion flow fuel fitting (Bottom).