

NATIONAL TRANSPORTATION SAFETY BOARD

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



May 1 2017

MATERIALS LABORATORY FACTUAL REPORT

Report No. 17-035

A. ACCIDENT INFORMATION

Place : Gilbert, AZ
Date : 9/17/2016
Vehicle : Cessna 182P, N20844
NTSB No. : WPR16FA183
Investigator : Albert Nixon

B. COMPONENTS EXAMINED

Eight portions of aluminum sheet metal were submitted for examination (figure 1).

C. DETAILS OF THE EXAMINATION

The eight pieces of aluminum sheet metal were recovered on the ground following an explosion and inflight fire on a Cessna 182 during an aerial exhibition involving pyrotechnics and sky diving. The pieces were recovered in a field remote from the crash site. The aluminum pieces are thought to have originated from a box constructed to contain two large sparkler type pyrotechnics. A photo of the box as it was attached to the left side landing gear arm before the accident is shown in figure 2. A cropped and magnified version of the same photo with the brightness enhanced is shown in figure 3. The pyrotechnics box was shop-made and appears to have an opening in the aft side for the ejecta of the sparkler devices. In figure 3, it appears that there are two pieces of sheet metal on the interior of the box running perpendicular to the long side of the box. These pieces of sheet metal have two circular holes in them, presumably to secure the pyrotechnic devices in place. The top of the box appears to have a lid with a long piano hinge one side. Overall the pyrotechnics box appears to have been fabricated by folded and riveted aluminum sheet metal.

The eight recovered portions of the pyrotechnics box are labeled 1 - 8 for the purposes of this report and are shown in figures 4 - 11 respectively.

After examination of the recovered portions of the pyrotechnics box, and comparison with the photo in figure 3, their relative position with respect to each other is shown in figure 12. The red dotted line in figure 12 represents the bottom footprint of the pyrotechnics box. Portion #8 did not have any features from which to establish its position with respect to the other portions.

Portions #1, #3 and #5 originated from the bottom of the pyrotechnics box. Portions #1 and #3 share a fracture surface and contain the holes used to mount the pyrotechnics box to the step on the landing gear arm. Portions #1 and #3 had overstress fractures around their periphery. Some of these fractures followed the fold lines.

Portion #5 was from the aft outboard corner of the pyrotechnics box. Portion #5 had a blackened-sooted appearance. Portion #5 exhibited overstress fractures around its periphery. The fractures around the outboard edges of this portion occurred at the fold lines.

Portions #2, #4, #6 originated from the outboard side of the pyrotechnics box (Figure 13). The screw holes for the piano hinge are distributed along the top edge of these portions. Portion #2 had fractures on the sides along the fold lines of the box as well as a fracture separating it from portion #4 (the fractures in between portions #2 and #4 are not mating). The fractured edges between portions #2 and #4 are deformed in a direction suggesting the applied force originated from the inside of the box. Portion #4 exhibited a folded over edge resembling a folded leaf petal. This folded over edge feature is consistent with explosive damage. The screw holes on portion #4 were torn. Portion #6 exhibited fractures along the box fold lines. Portion #6 exhibited deformation consistent with the applied force originating on the inside of the box.

Portions #5 and #6 originated from the aft outboard corner of the pyrotechnics box (Figure 14). Both portions exhibited a blackened-sooted appearance on their inward facing surfaces. These two portions separated from each other along the fold line. Both of these portions also exhibited fractures along the aft fold lines of the box. There was a rivet hole in portion #6 that fractured and was deformed inward with the rest of portion #6 being deformed outward.

Portions #2 and #1 originated from the forward outboard corner of the pyrotechnics box (figure 15). These two portions separated from each other along the fold line. Both of these portions also exhibited fractures along the forward fold lines of the box.

Portion #7 originated from the aft part of the pyrotechnics box (Figures 10, 3). This portion exhibited blackened-sooted regions on both the interior and exterior surfaces. The deformation and rivet pullouts are consistent with a force originating from inside the box.

The origin of portion #8 could not be established based on any features contained within the part (figure 11). Portion #8 exhibited multiple fracture surfaces and torn edges that had curled over consistent with explosive damage.

Portions #6, #5 and #7 all exhibited a blackened-sooty interior surface. Portion #4 did not exhibit this same level of staining but did exhibit a peppering of little craters on the surface of the interior side (figure 16). This evidence of cratering is consistent with high velocity particle impact associated with an explosion originating in the interior of the box. Similar cratering was observed on the interior sides of portions #5 and #6.

In aggregate, the high degree of fragmentation, the fractures along the fold lines, the outward deformation, the pedaling and curling on some of the edges and the cratering from particle impacts are consistent with an explosion originating inside the pyrotechnics box.

Joseph Panagiotou
Fire Protection Engineer

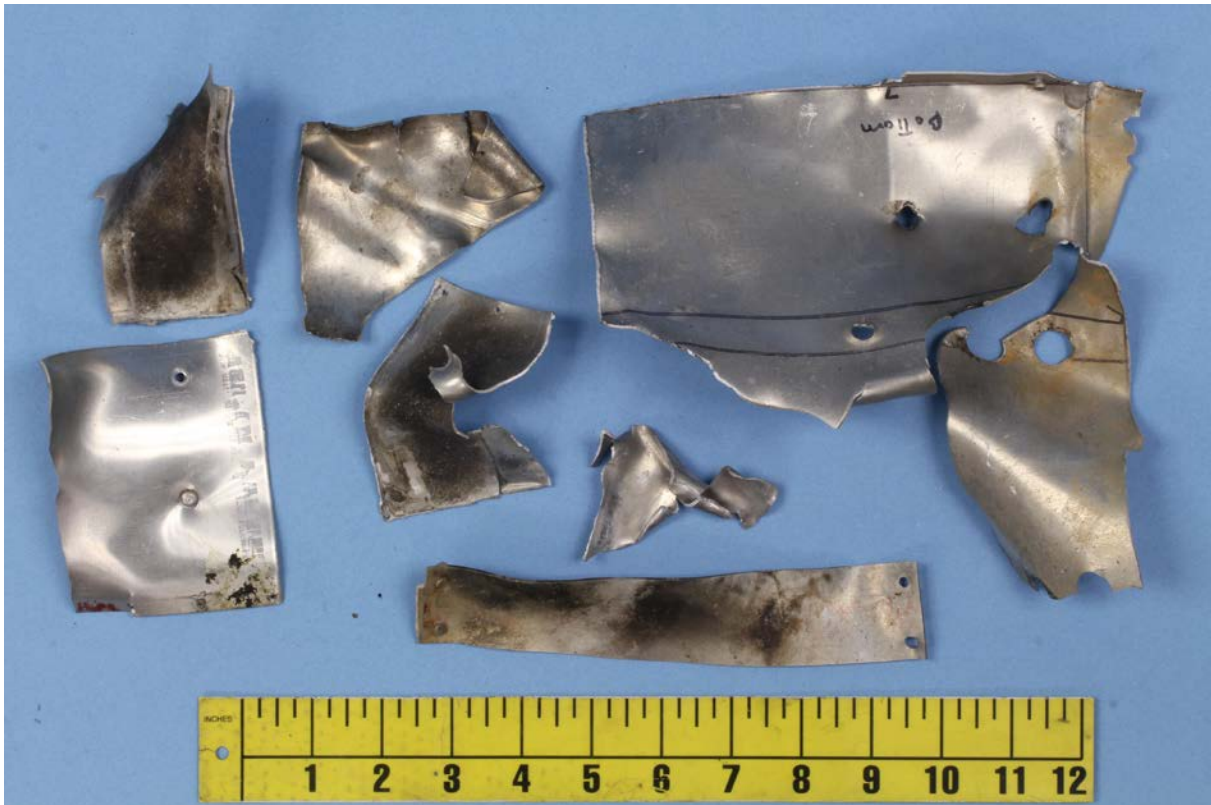


Figure 1: Eight portions of aluminum sheet metal as received.



Figure 2: Pyrotechnics box as mounted on the left main landing gear arm.

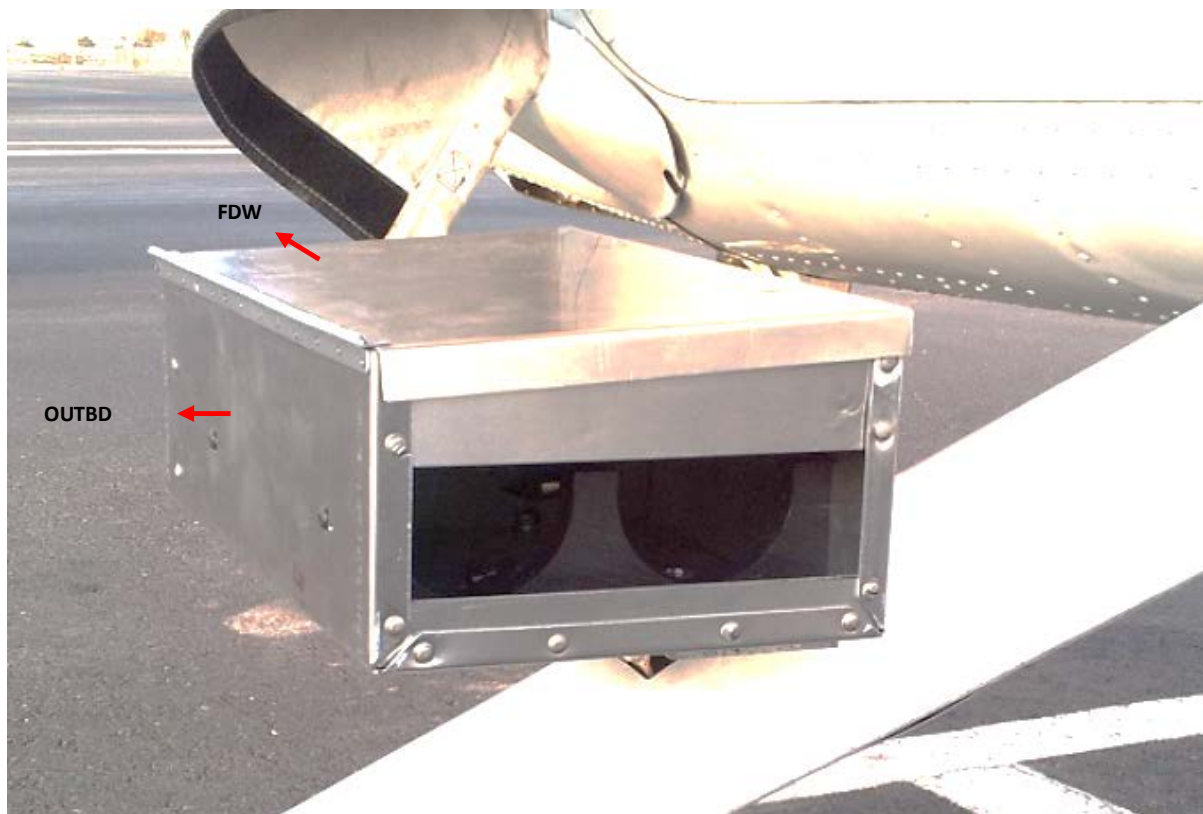


Figure 3: Magnified and brightened photo of the pyrotechnics box.

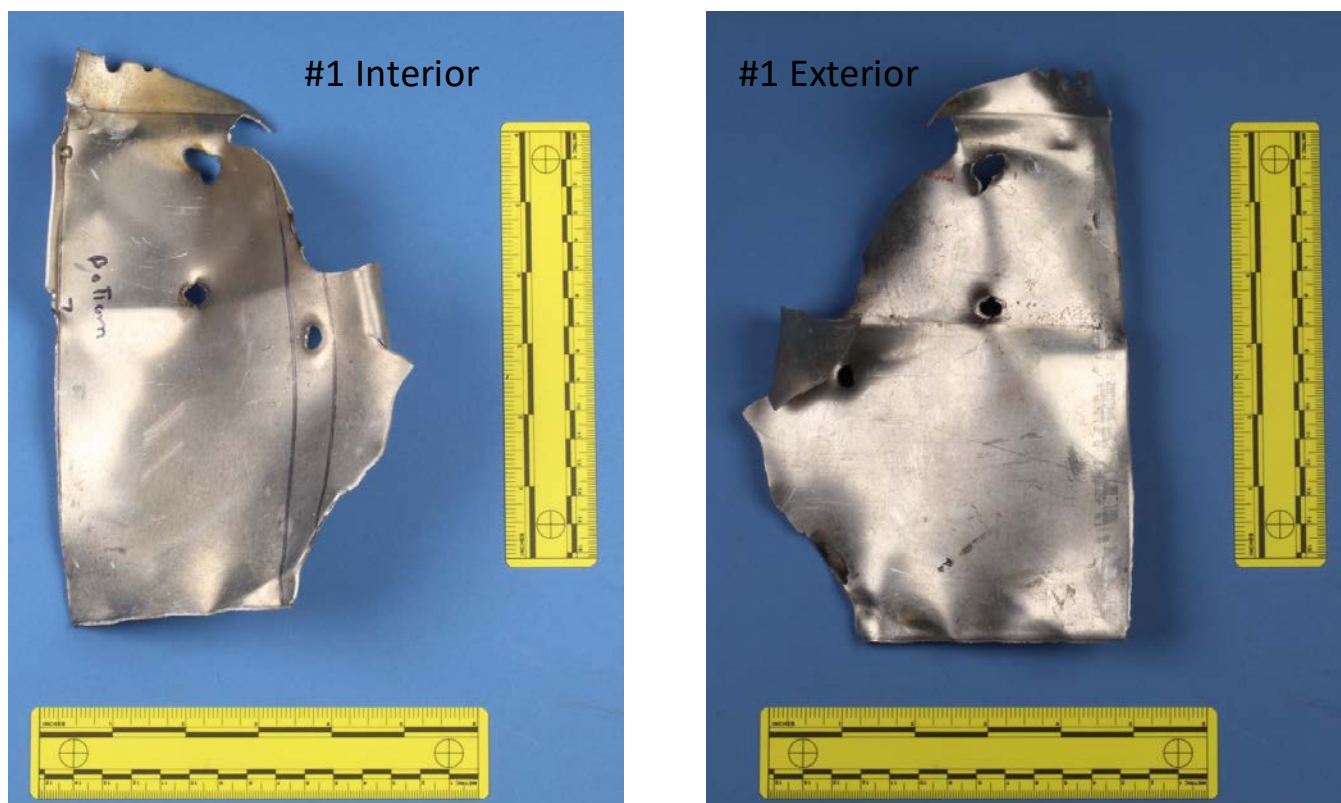


Figure 4: Portion #1 (both sides shown).

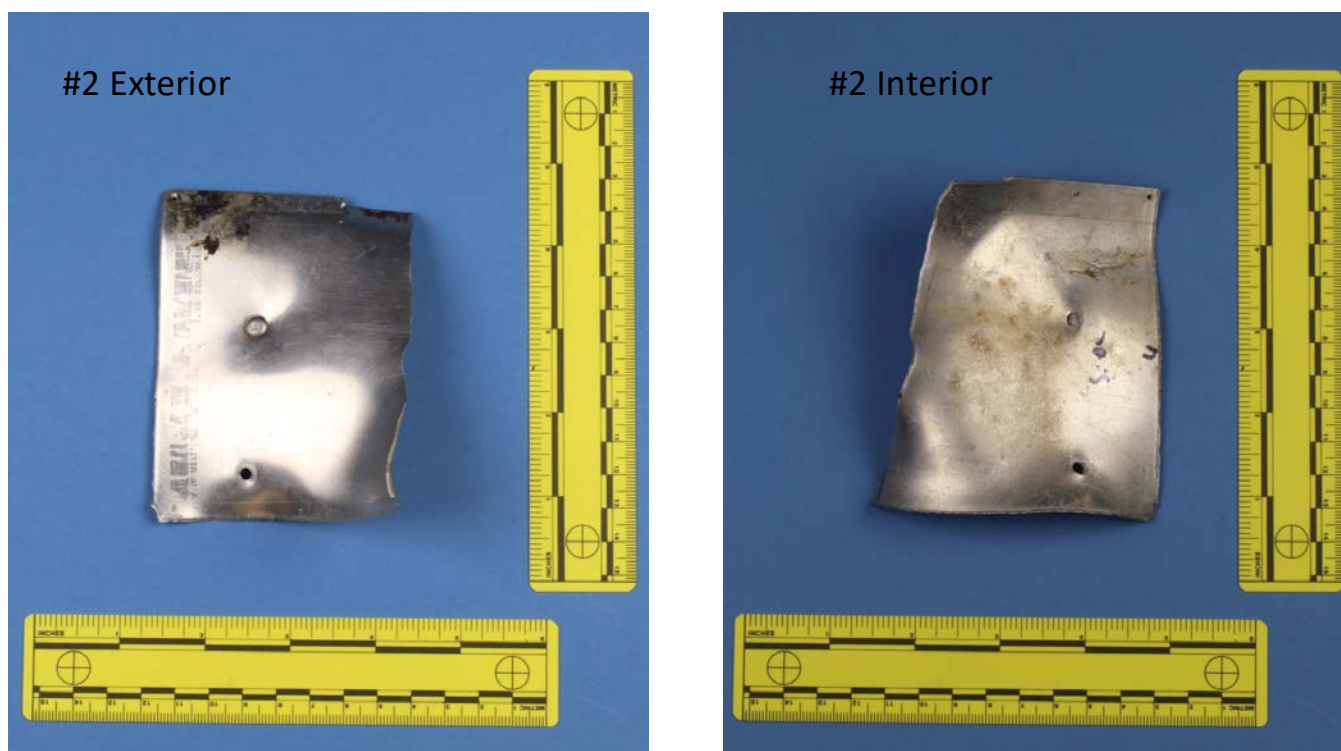


Figure 5: Portion #2 (both sides shown).

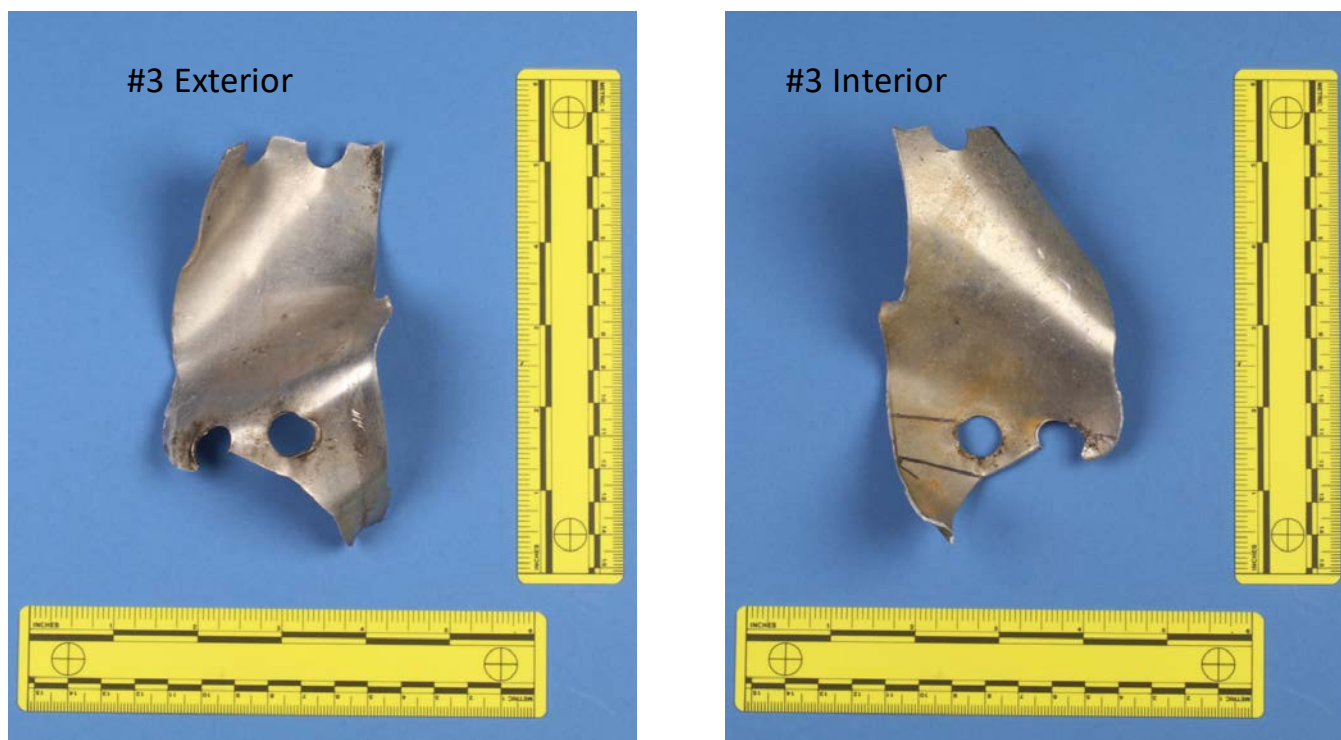


Figure 6: Portion #3 (both sides shown).

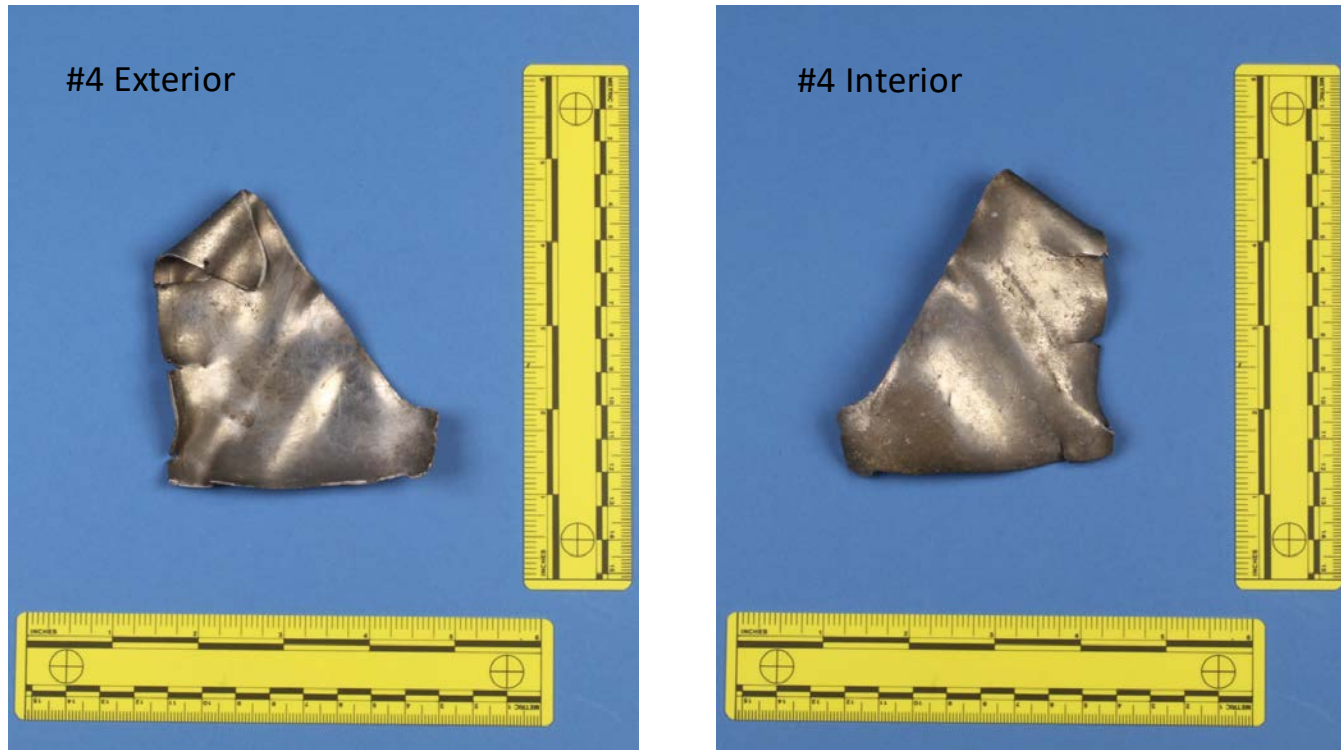


Figure 7: Portion #4 (both sides shown).

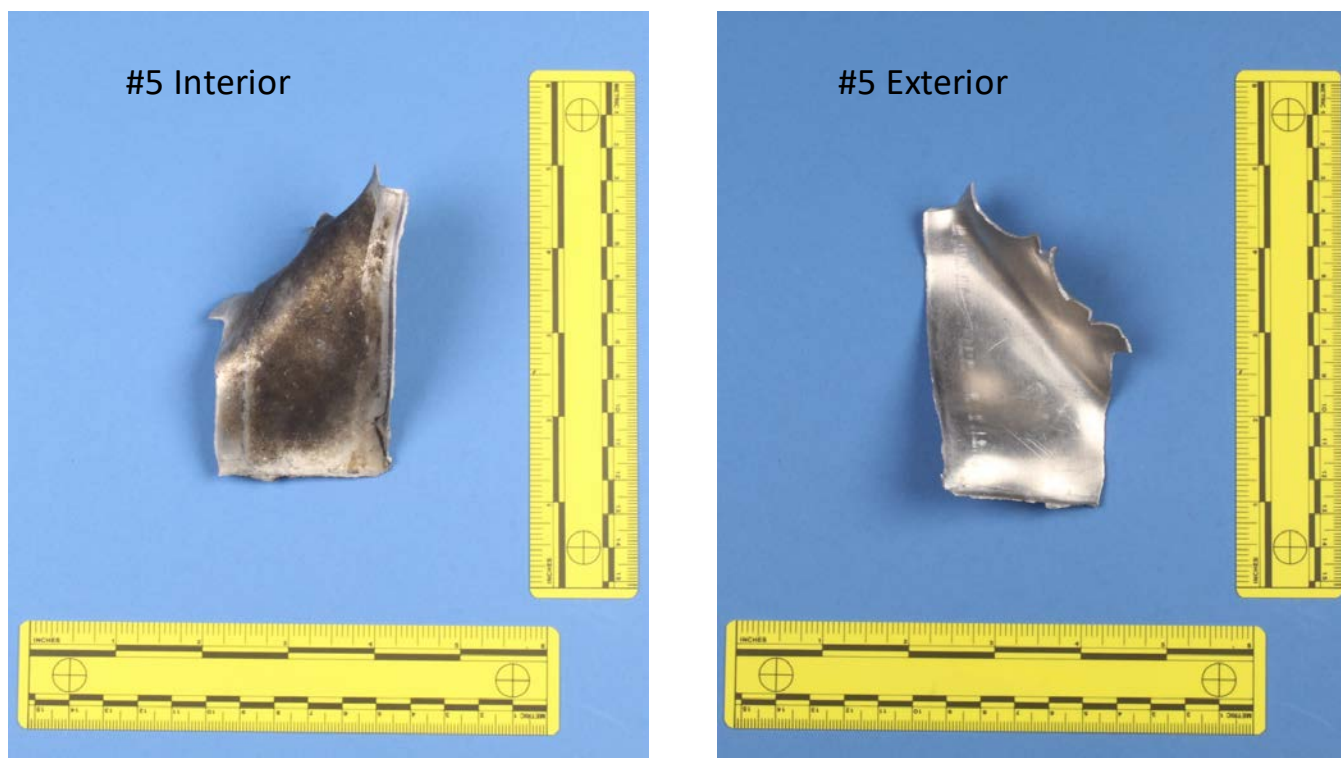


Figure 8: Portion #5 (both sides shown).

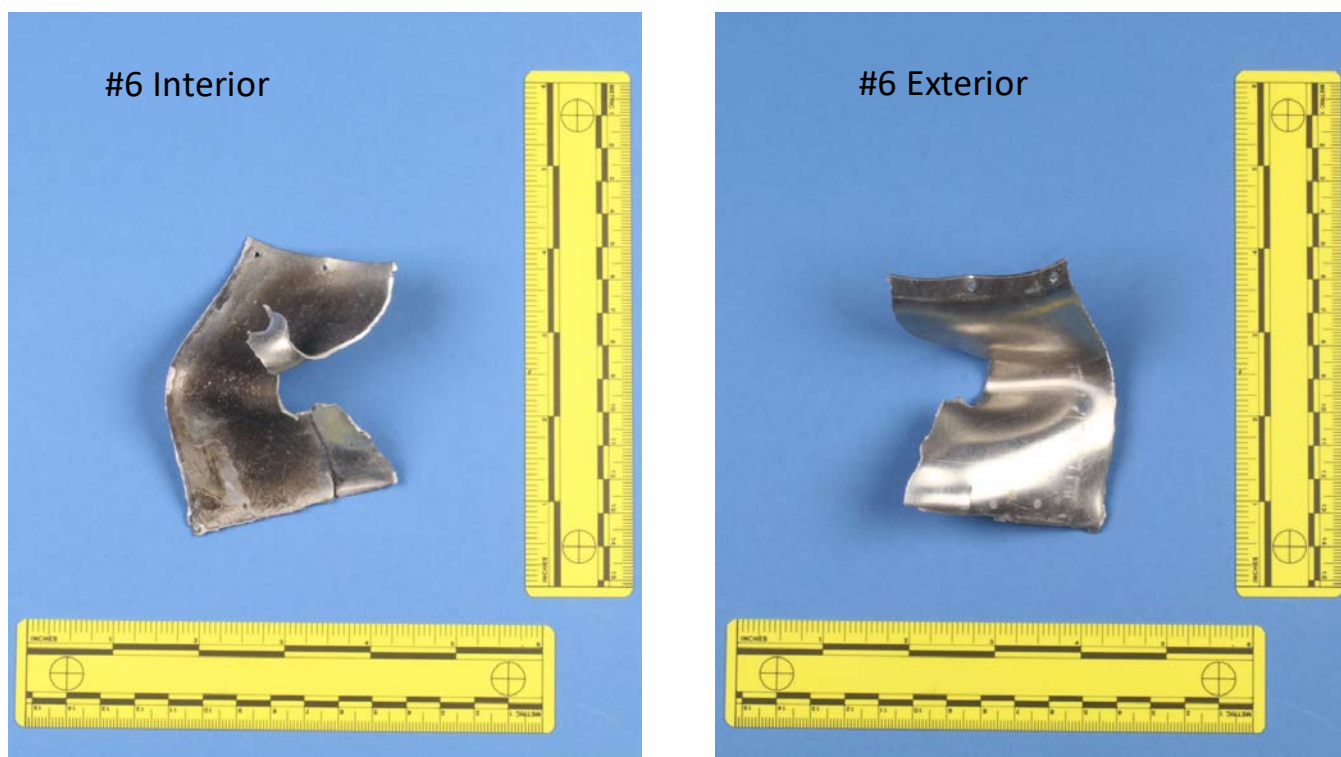


Figure 9: Portion #6 (both sides shown).



Figure 10: Portion #7 (both sides shown).

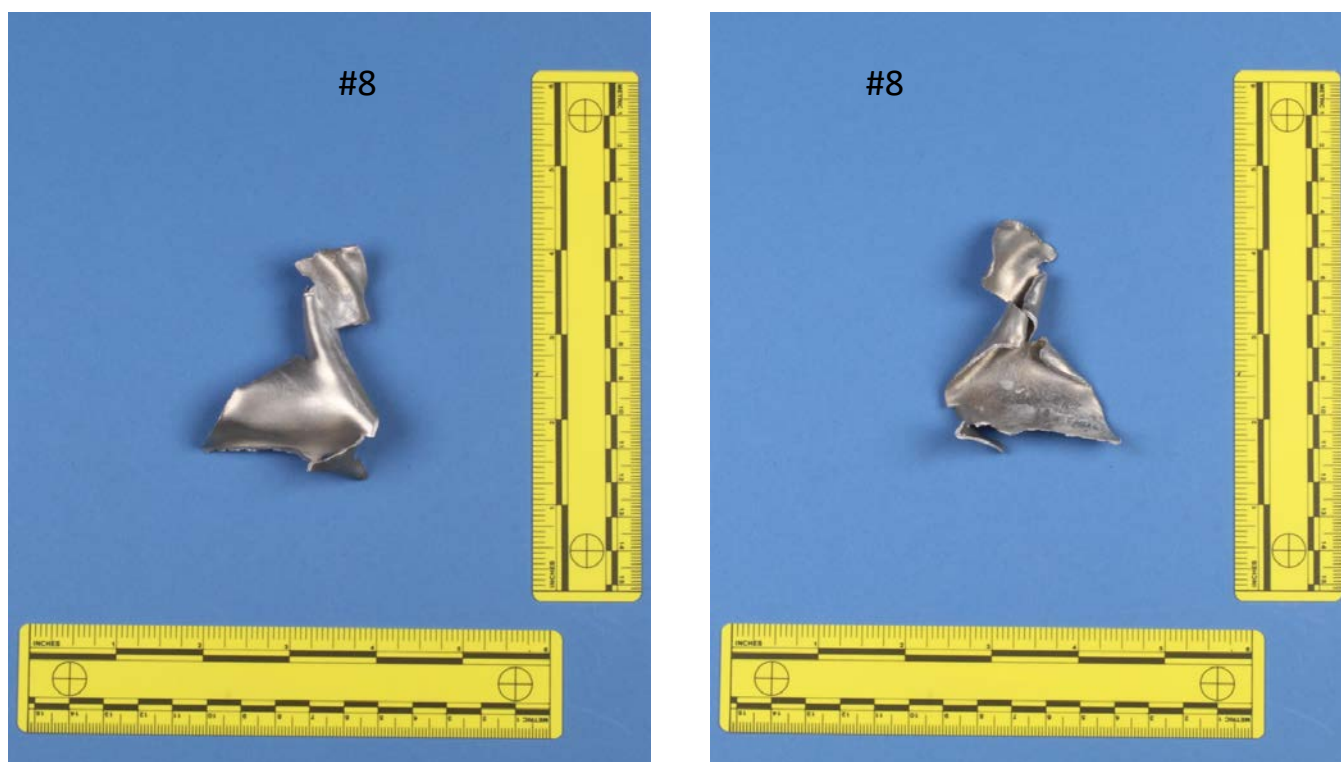


Figure 11: Portion #8 (both sides shown).

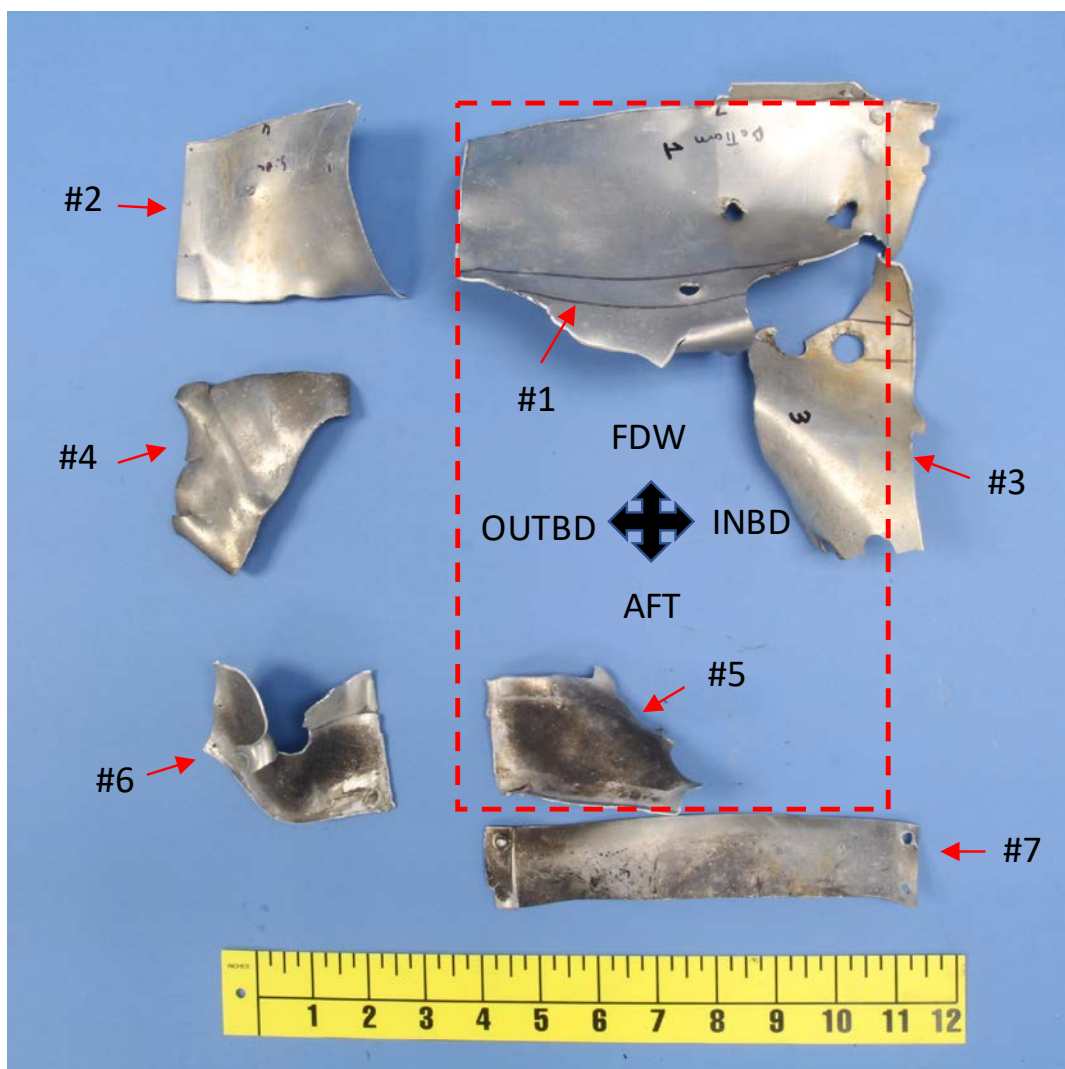


Figure 12: Relative positions of pyrotechnics box portions with respect to each other. The dashed line rectangle denotes the footprint of the pyrotechnics box. This view shows the interior surface of the portions.

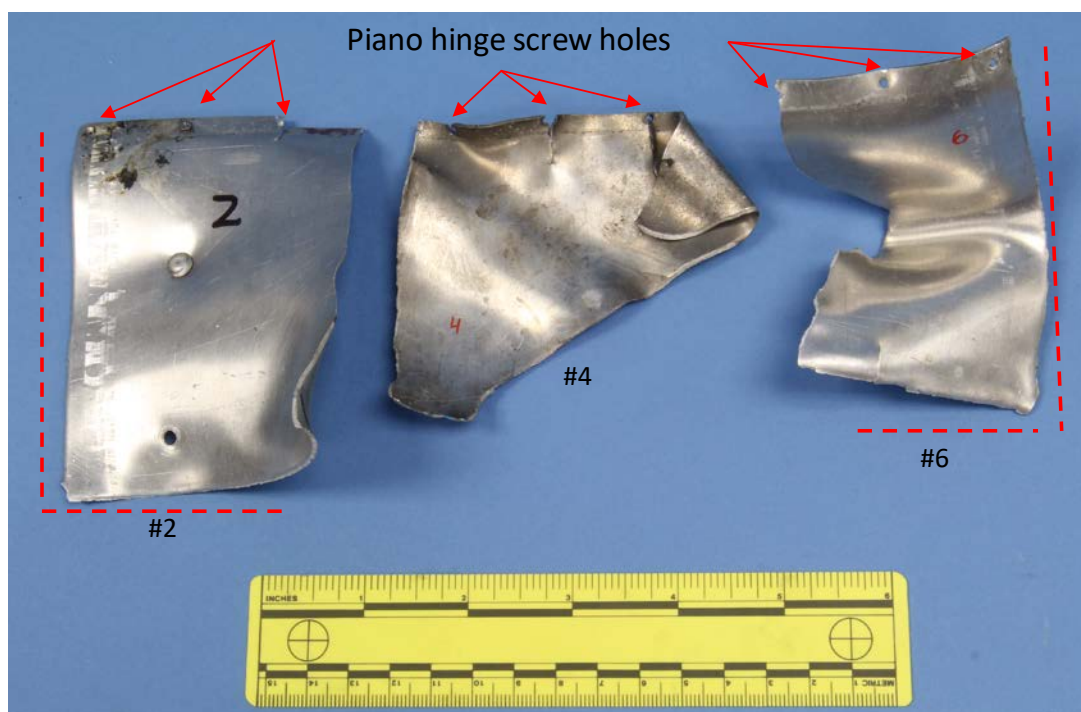


Figure 13: Portions from the outboard side (see figures 12 & 3 for orientation) of the pyrotechnics box. The dashed lines show the fold lines of the box. This view shows the exterior surfaces of the portions.

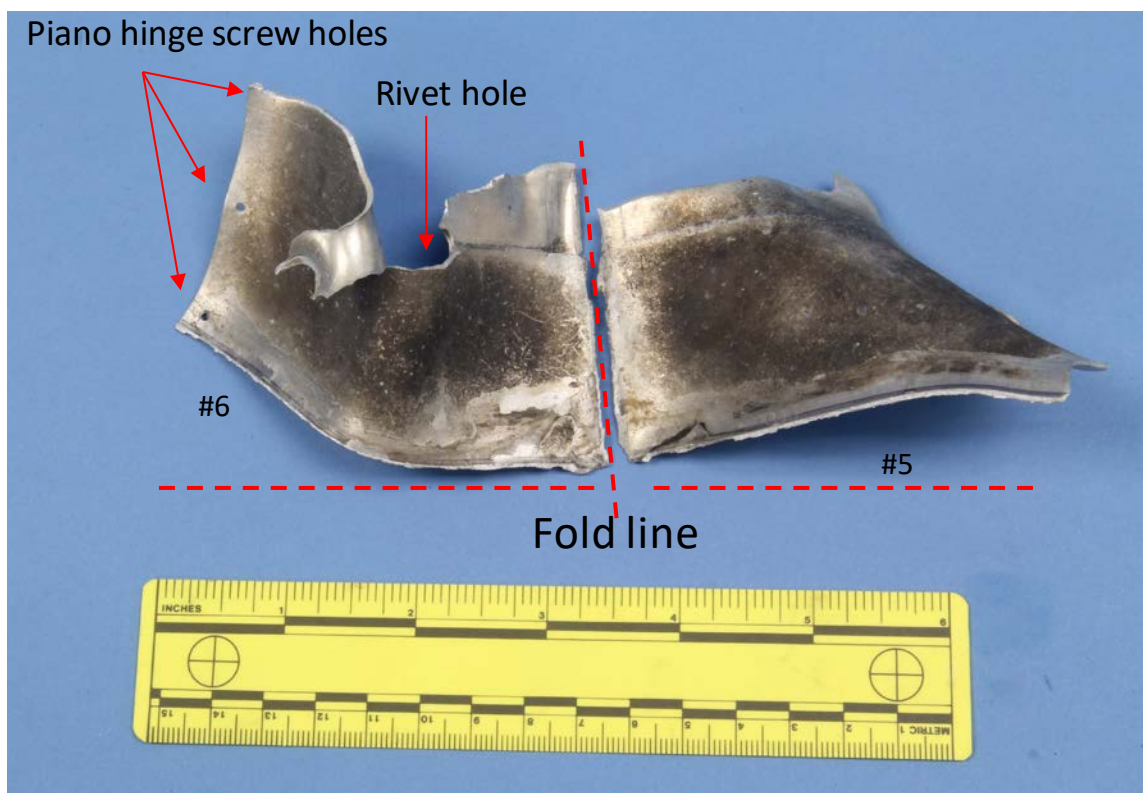


Figure 14: portions from the aft outboard corner of the pyrotechnics box (see figures 12 & 3 for orientation). The dashed lines show the fold lines of the box. This view shows the interior surfaces of the portions.

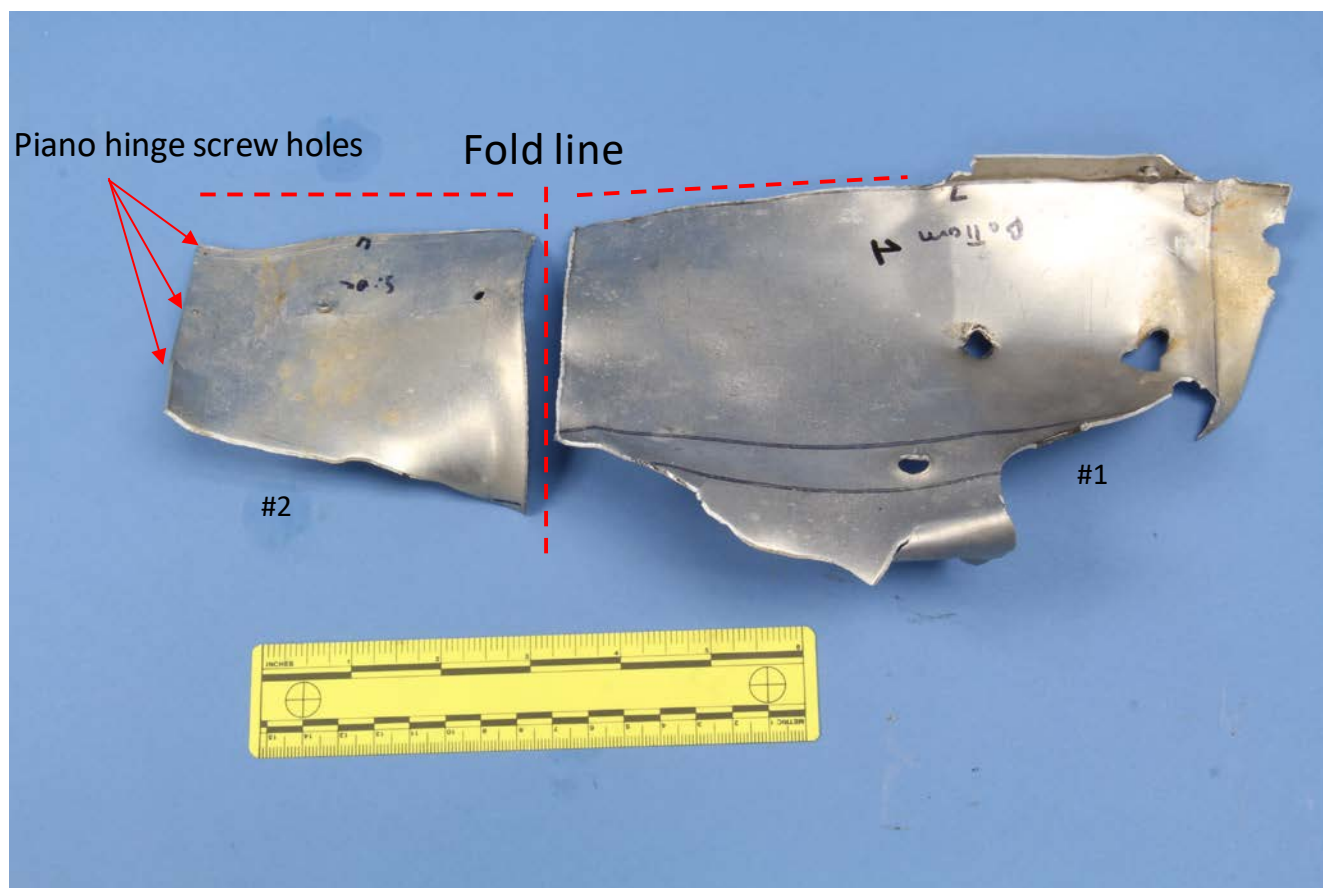


Figure 15: Portions from the forward outboard corner of the pyrotechnics box (see figures 12 & 3 for orientation). The dashed lines show the fold lines of the box. This view shows the interior surfaces of the portions.



Figure 16: Particle impact craters on interior surface of portion #4.