NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

December 1, 2008

MATERIALS LABORATORY FACTUAL REPORT

Report No. 08-116

A. ACCIDENT

Place	:	San Francisco, California
Date	:	June 28, 2008
Vehicle	:	Boeing 767-200 Freighter
NTSB No.	:	DCA08MA076
Investigator	:	Lorenda Ward

B. COMPONENTS EXAMINED

The components examined were from the oxygen system and ventilation system serving the supernumerary compartment of the accident aircraft.

Components from the oxygen system:

- Two portions of a melted stainless steel 90 degree elbow
- Two stainless steel 90 degree elbows
- A portion of an oxygen mask
- Portions of oxygen mask harness material and fittings
- A portion of an oxygen mask stowage box
- Portions of flexible oxygen lines
- Stainless steel oxygen lines from the overhead area

The component from the ventilation system consisted of a portion of a ventilation duct from the overhead area.

C. DETAILS OF THE EXAMINATION

Portion of oxygen mask

The portion of the oxygen mask (figure 1) that was examined had been severely fire damaged, having melted and deformed, and did not resemble its original shape. It was identified as being a portion of the oxygen mask by the microphone assembly, which was metallic and had not been deformed. Overall this item had a black, charred appearance, and was friable when handled. The main body of the oxygen mask was comprised of a plastic material, which had melted, and resolidified into an amorphous mass with the microphone stuck to it by means of wires, which would have carried the signal from the microphone.

Portions of oxygen mask harness and fittings securing the harness to the mask

Small portions of the oxygen mask harness (figure 2) that were recovered exhibited severe thermal damage and had become charred and friable. The aluminum fittings (figure 3) that were used to secure the harness to the oxygen mask had reached their incipient melting temperature and had became deformed. These fittings had a heavy oxide formation on their outer surface. Portions of charred harness material were still present inside these fittings.

Figure 1: Portion of oxygen mask

Figure 2: Portions of oxygen mask harness

Figure 3: Oxygen mask harness fittings

Fitting between oxygen mask and oxygen mask stowage box

An aluminum fitting (figure 4) which would connect the oxygen mask to the oxygen mask stowage box had sustained severe thermal damage. The fitting was deformed indicating that it had reached its incipient melting temperature. The end of the fitting that would have been contained within the stowage box had remnants of the flexible line that would have been supplying it with oxygen. This remnant of the flexible oxygen line was friable and white in appearance.

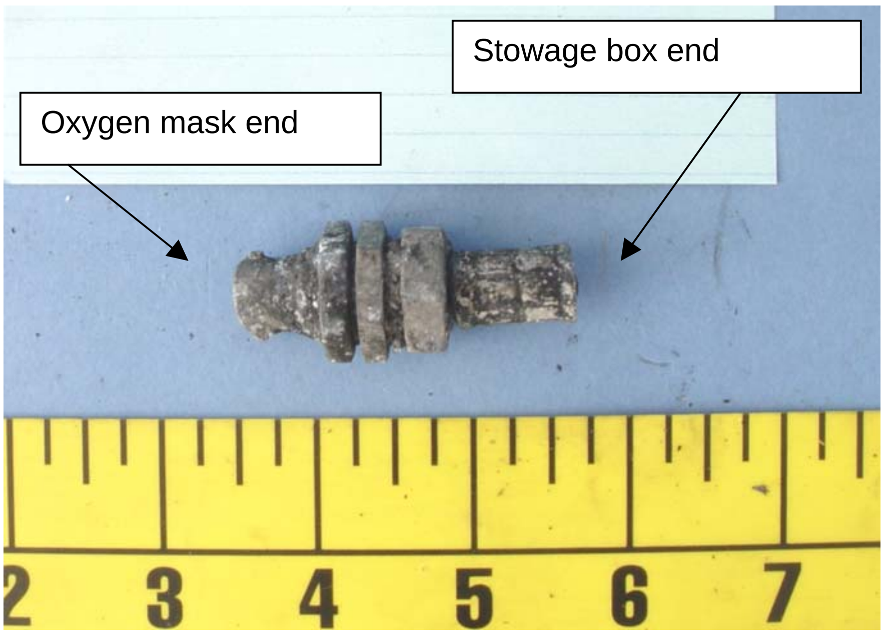

Figure 4: Fitting connecting an oxygen mask to an oxygen mask stowage box

Portions of flexible oxygen lines

The portions of the flexible oxygen lines (figure 5) that were recovered appear to be of the type connecting oxygen masks to the oxygen mask stowage boxes. The over braid which would cover the inner flexible PVC tubing was heavily charred and brittle. The inner portions of the tubing were white in appearance and friable when handled. Some of the small portions of the white colored tubing were blackened on the inner surface. One portion of tubing that was approximately 8 inches in length had a heavily charred over braid and the flexible tube inside was olive green in color. This tube was sectioned to observe the inner surface, which was found to have sustained lesser thermal damage than the exterior surface. The photograph in figure 5 shows a portion of the tube that was sectioned. This tubing was still pliable although it would fracture when bent a sufficient amount. Examination of the corresponding flexible oxygen lines from exemplar components found that the tubing they were constructed with was white in color. The olive green flexible tubing appears to have been olive green from manufacture and not caused by exposure to high temperature.

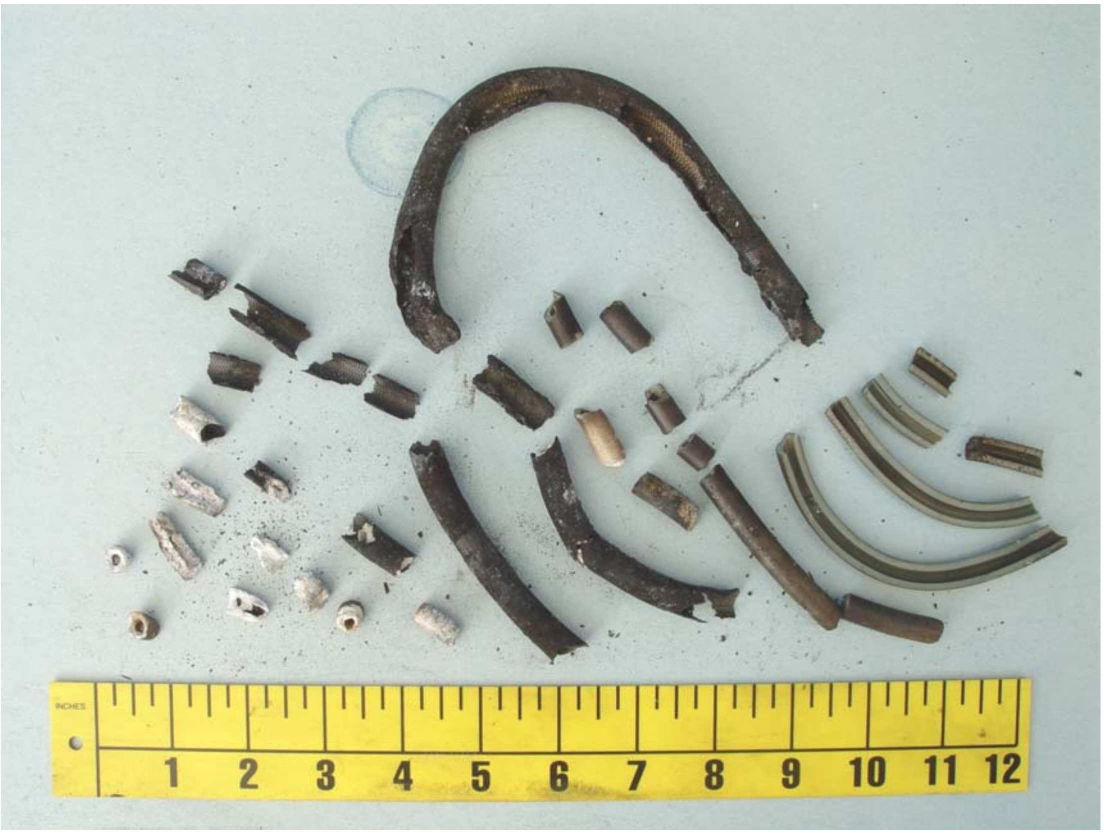

Figure 5: Portions of flexible oxygen lines consistent with those used to connect oxygen masks to oxygen mask boxes

Portion of oxygen mask stowage box

The portion of the oxygen mask box (figures 6 & 7) was found on the floor deck between the location of the weight and balance computer and the right seat frame of the supernumerary seating. The portion of the mask box was severely fire damaged and only approximately half of the box remained. The fitting that would connect the stowage box to the oxygen mask was still attached. The left hand side of the box as well as the rear panel was missing. The rear most section of the right hand side of the box was also missing. The bottom of the box was also missing as well as the left rear portion of the top.

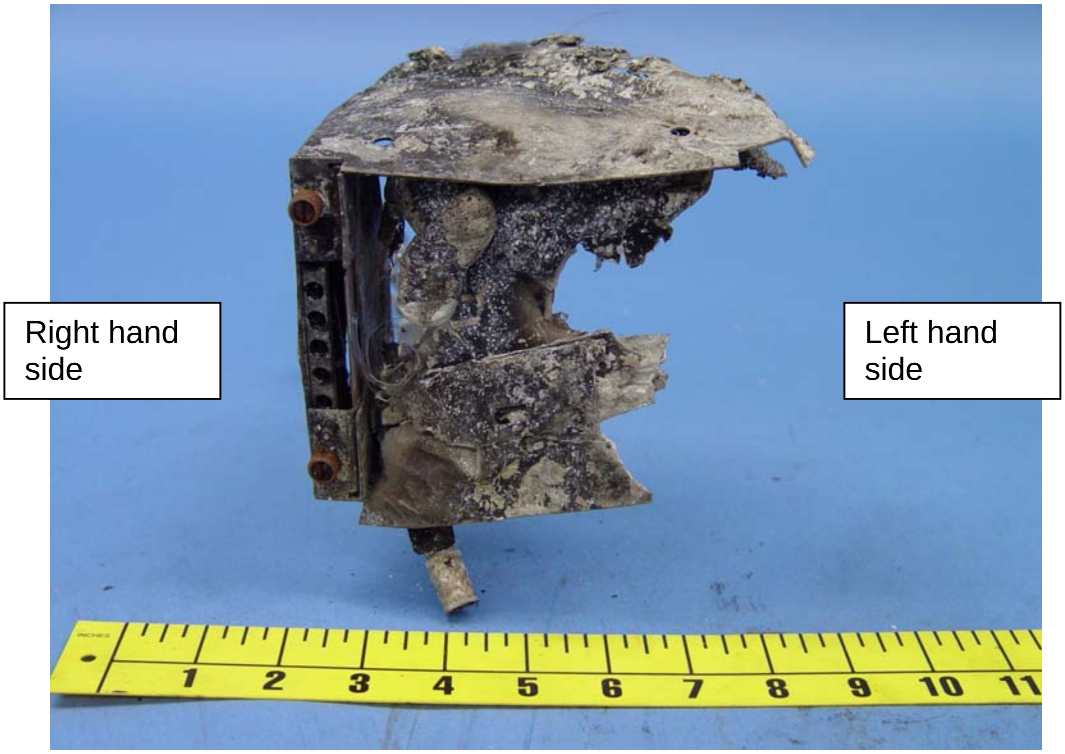

Figure 6: Oxygen mask stowage box as viewed from the front.

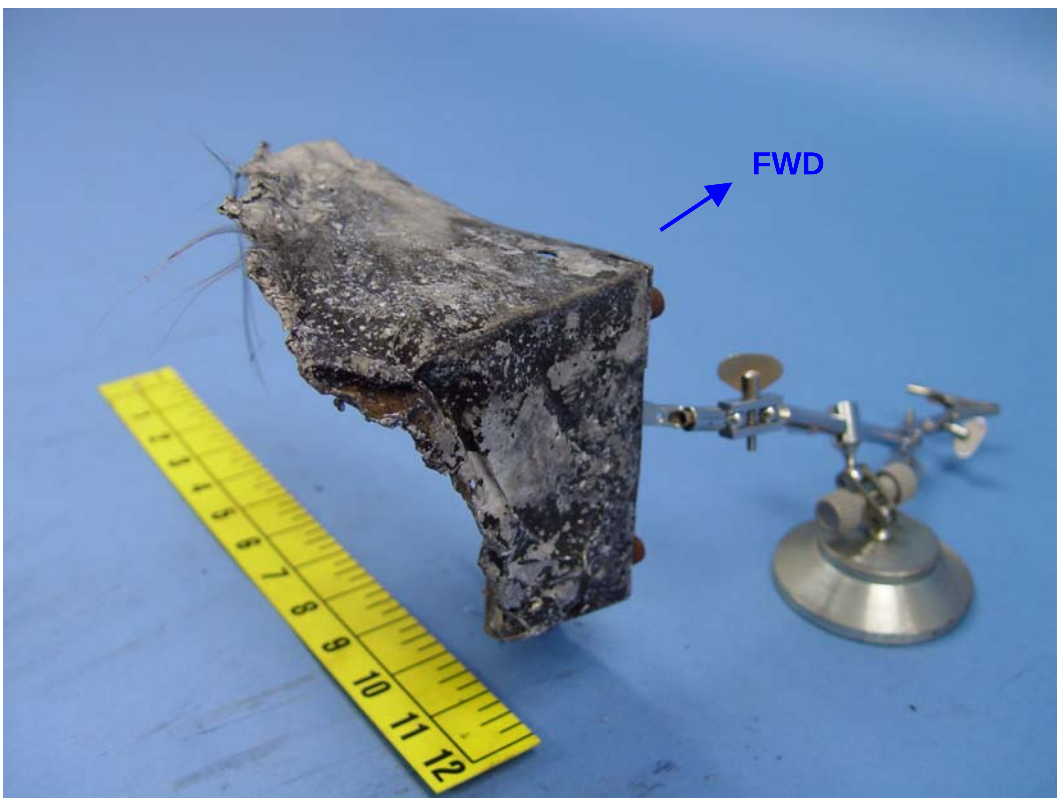

Figure 7: Oxygen mask stowage box as viewed from right hand rear corner

Stainless steel 90-degree elbow with large portion of an aluminum fitting

A stainless steel tube forming a 90-degree elbow (figure 8) was found in the fire damaged supernumerary compartment. This tube was found on the floor deck near the centerline of the compartment at the base of the bulkhead separating the supernumerary compartment and the main cargo deck. This tube was intact but heavily oxidized, consistent with being exposed to a high temperature fire environment. A large portion of the aluminum AN type fitting that would connect this tube to one of the oxygen mask stowage boxes was still attached to the down stream end of the elbow. This fitting broke off during examination. The fitting had evidence of having reached its incipient melting temperature and was slightly deformed. The upstream end of the elbow had remnants of an aluminum fitting adhering to the threads of the stainless steel threaded nipple at the end of the tube.

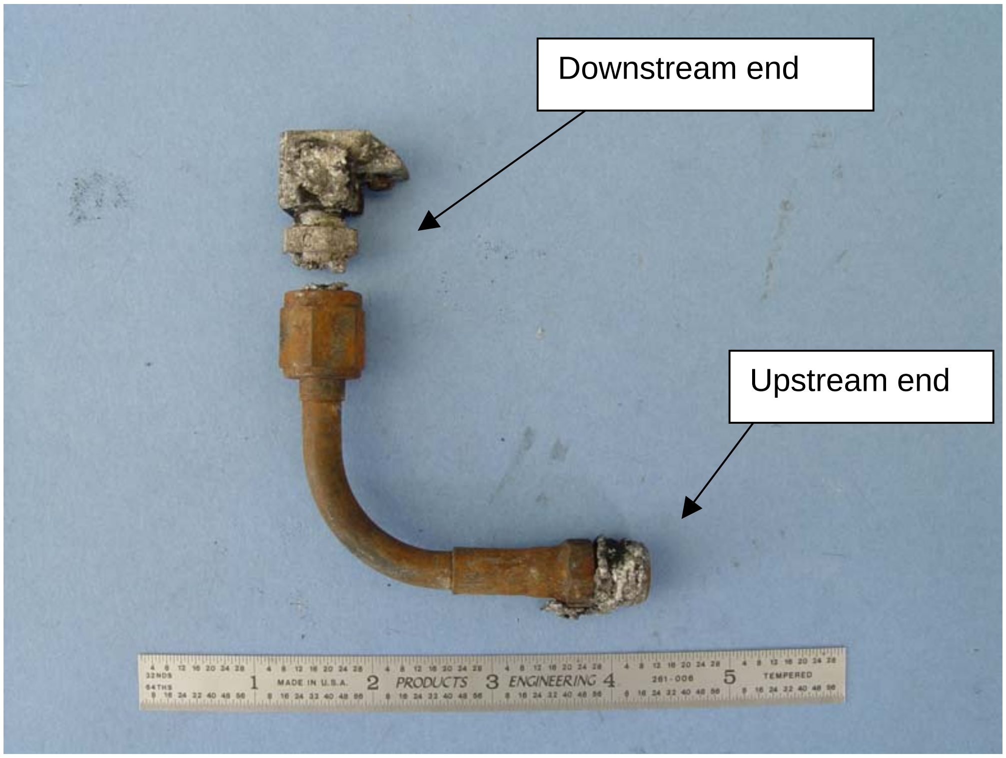

Figure 8: Stainless steel elbow with large portion of an aluminum fitting

Stainless steel 90-degree elbow with remnants of aluminum fittings

A second stainless steel 90-degree elbow (figure 9) was also recovered near the centerline of the supernumerary compartment at the base of the bulkhead separating the supernumerary from the main cargo deck. This 90-degree elbow was also intact and exhibited heavy oxidation consistent with exposure to a high temperature fire environment. This elbow had remnants of an aluminum fitting adhering to the threaded nipple on the up stream portion of the elbow. The down stream portion of the elbow had a portion of the AN type aluminum fitting still contained within the stainless steel nut.

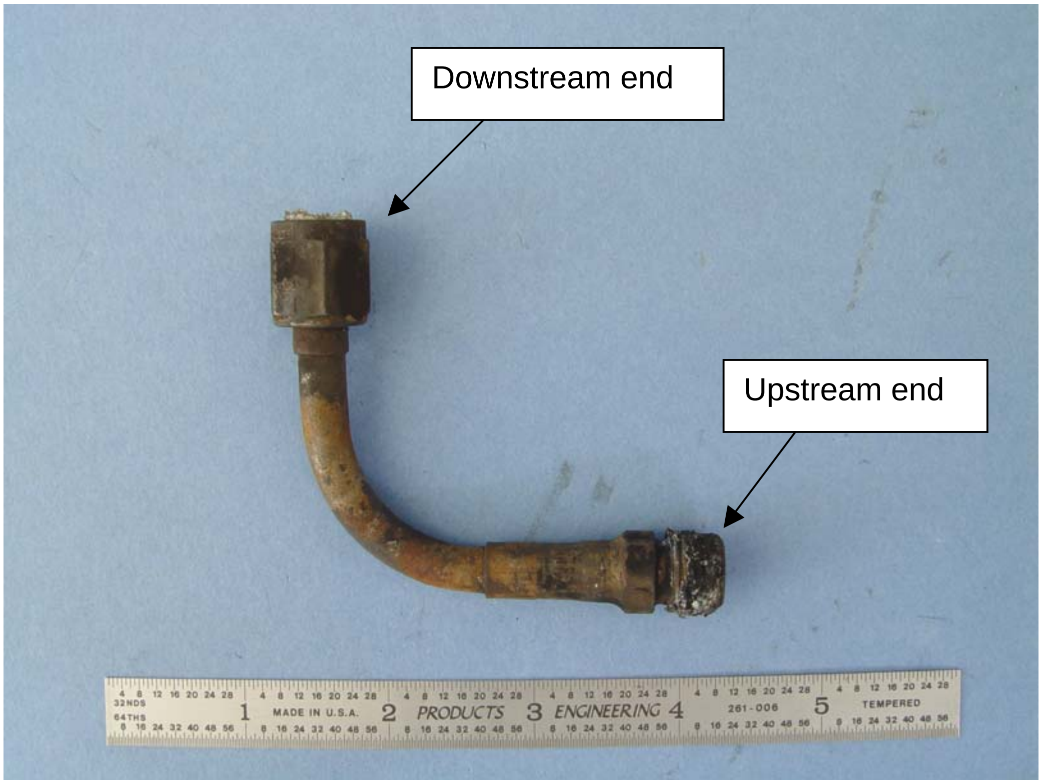

Figure 9: Stainless steel elbow with remnants of aluminum fittings

Portions of 90-degree stainless steel elbow

Two portions of a third 90-degree stainless steel elbow (figure 10) were recovered from the floor deck of the supernumerary compartment at the base of the bulkhead between the location of the right hand seat frame and where the weight and balance computer would have been. The two portions of the elbow were heavily oxidized and melted at the location of the radius of the 90-degree bend. The location of the melting was concentrated along the inner radius of the bend and on the portion of the tube that would have been facing toward the aft of the aircraft when attached to the oxygen mask stowage box. The upstream portion of the elbow had the aluminum fitting still attached and in intact condition although exhibiting surface oxidation. At the location where this upstream portion of the elbow had melted, the resolidified metal appeared to have slumped inward into the tube (figure 11). An approximately 2.5 inch portion of the wire spiral that would have been contained within the flexible oxygen line and connected to the elbow through the aluminum fitting was still present. This wire spiral was hooked into a small hole in the end of the aluminum fitting on the upstream portion of the elbow, but not rigidly connected (figure 10). The upstream end of the wire spiral had evidence of melting and re-solidification (figure 12). The down stream portion of the elbow had the aluminum AN type fitting still attached. The fitting had reached its incipient melting temperature and had deformed. Close examination revealed that it had softened and bent out of plane with the elbow but had not rotated out of position.

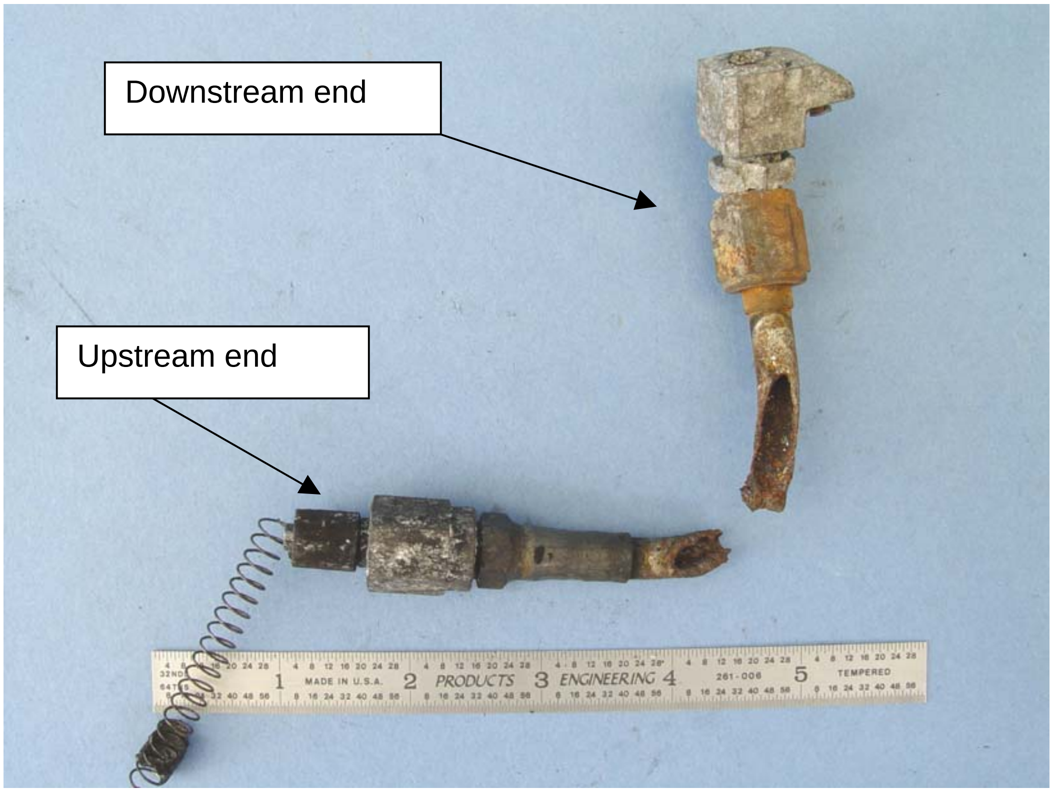

Figure 10: Two portions of 90-degree stainless steel elbow with aluminum fittings

Figure 11: Melted area of up stream portion of 90-degree elbow

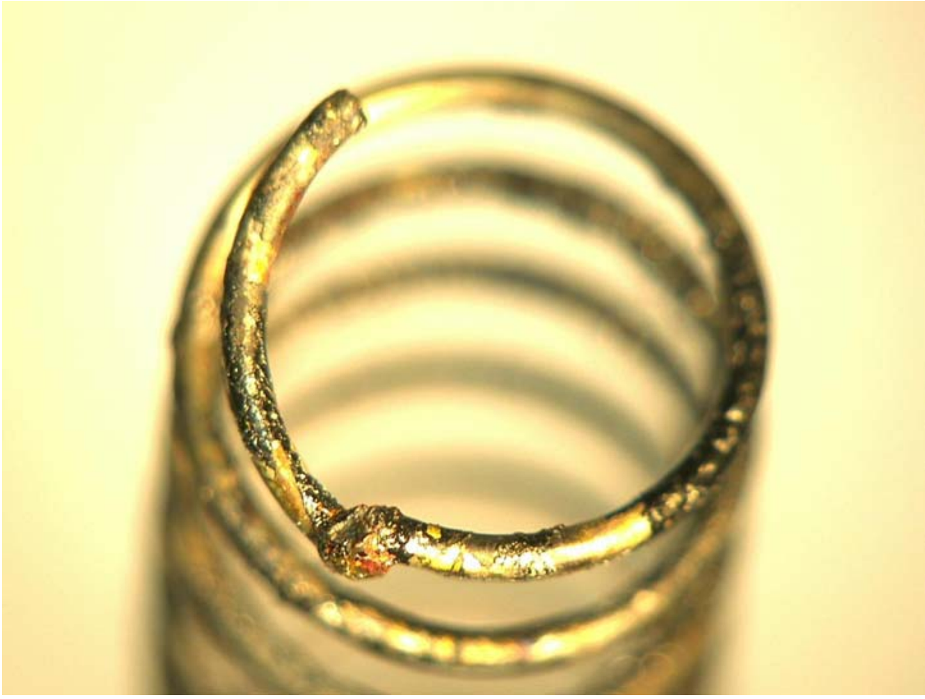

Figure 12: Up stream end of wire spiral exhibiting evidence of melting and re-solidification

Stainless steel oxygen lines

A portion of the rigid stainless steel lines that delivered oxygen from the below deck oxygen cylinder up to the bulkhead above the supernumerary compartment oxygen mask stowage boxes was examined. This portion consisted of the section spanning from just behind the galley bulkhead and ending at the fittings where the flexible oxygen lines would have been connected (figures 13, 14). For shipping purposes this portion of the oxygen distribution line was cut into smaller sections, which are labeled in the photos.

Section #1

Section #1 of the stainless steel tubing (Figure 13) was cut from just behind the galley bulkhead and extended just past the first union fitting within the supernumerary compartment. The tubing generally had a dark grey color with some brown colored areas consistent with oxidation from exposure to a high temperature fire environment. In particular an orange brown stain was found on both ends of the union fitting included within this section of tubing. This stain was observed where the tube entered the nut. No mechanical damage was observed on this section and no evidence of electrical arcing was found. This section was pressure tested at 120 psi and no leaks were observed.

Section #2

Section #2 of the stainless steel tubing (figure 14) was cut from between the first and second union fittings within the supernumerary compartment. This section would have been located in the overhead area above the ceiling panels extending from the area of the galley to just before the bulkhead above the oxygen mask stowage boxes. The tubing was bent from its original shape to accommodate shipping. This section had a dark grey appearance consistent with oxidation from exposure to a high temperature fire environment. Small flecks of re-solidified aluminum were found adhering to the surface of the tubing. No mechanical damage was observed on this section and no evidence of electrical arcing was found. This section of tubing was pressure tested to 120 psi and no leaks were observed.

Section #3

Section #3 of the stainless steel tubing (figure 13) contained the second union fitting within the supernumerary compartment. This section would have been oriented vertically leading from the overhead area down into the bulkhead above the oxygen mask stowage boxes. The tubing and fitting were dark grey in appearance consistent with exposure to a high temperature fire environment. A small fleck of re-solidified aluminum was found adhering to the exterior surface of the tubing. No mechanical damage was observed on this section and no evidence of electrical arcing was found. Pressure testing at 120 psi revealed that there was a small leak at the union fitting at the location where a ferrule of the union fitting was attached to the tubing. This leak was very small, producing only a few tiny bubbles when a soap water solution was applied.

Section #4

Section #4 of the stainless steel tubing (figure 13) was located within the bulkhead above the oxygen mask stowage boxes. It would have been oriented horizontally a few inches above the height of the oxygen mask stowage boxes. This section of the tubing contained three fittings. Connected to these fittings would have been flexible PVC oxygen lines to supply the oxygen mask stowage boxes. The upstream most fitting was a T fitting, the middle fitting was also a T fitting and the fitting at the end of the line was a 90-degree elbow. The tubing contained within this section had a light grey appearance consistent with minor oxidation. This oxidation appears to be less than that observed on sections #1, #2 and #3. No evidence of mechanical damage or electrical arcing was observed on the tubing contained within this section. The most upstream T fitting had light blue/green discoloration on the threads (figure 15) and darker blue discoloration inside the body of the fitting. This threaded connection is where the flexible oxygen line would have attached. This light blue discoloration is consistent with the area having reached a high temperature. No remnants of the aluminum nut, which would have been attached at this location, were observed. The middle T fitting (figure 16) did not appear to have any discoloration on the visible portion of the threads or inside the fitting body. Remnants of the aluminum fitting attaching the flexible PVC oxygen line to this T fitting were found adhering to the threads. This fitting did not have any evidence of physical damage. The last fitting on the stainless steel oxygen line, the 90-degree elbow (figure 17), did not have any discoloration. The threads of this fitting did not have any remnants of the aluminum fitting which would have attached the flexible PVC oxygen line at this location. Re-solidified aluminum was observed on the inside of the fitting while looking in from the open end.

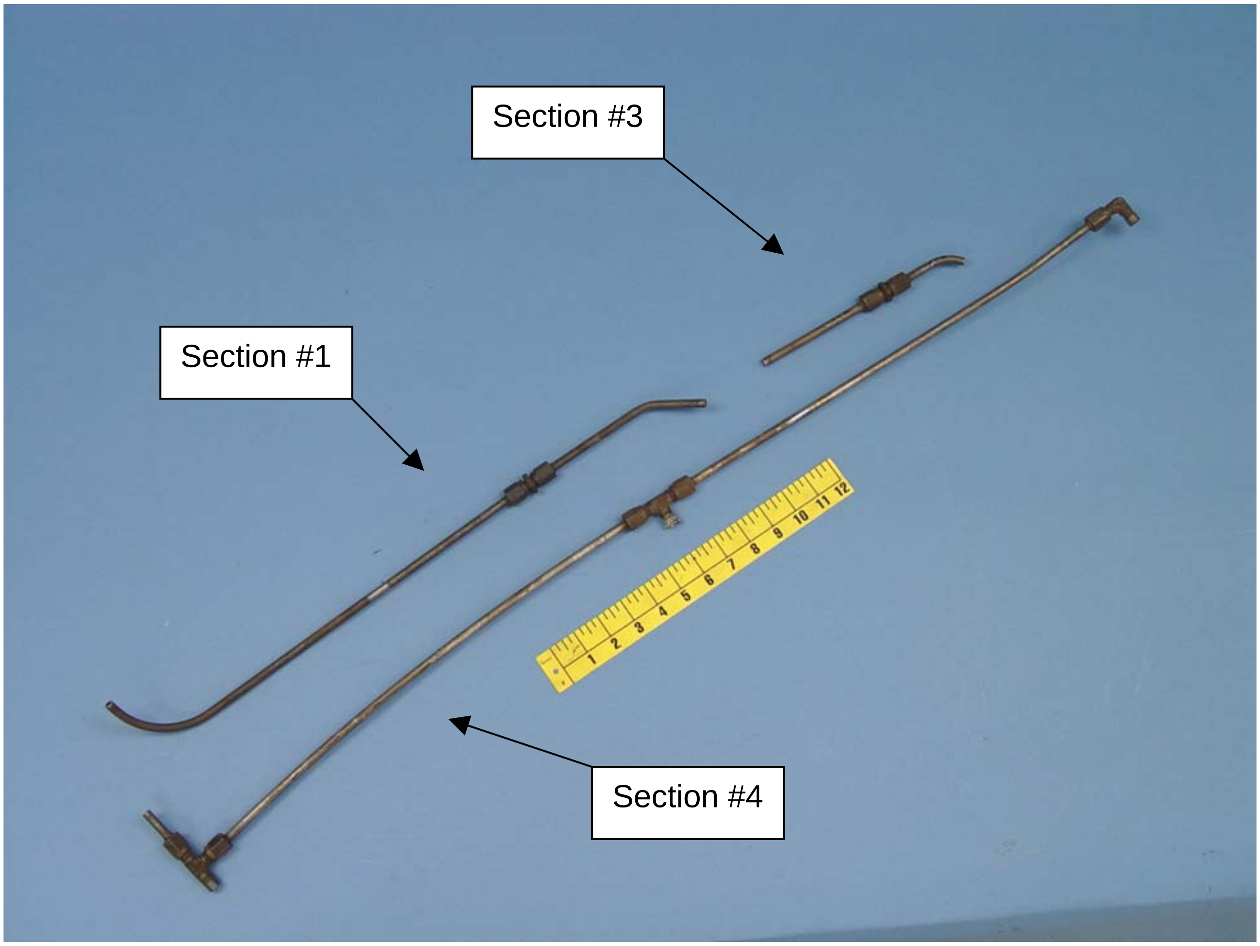

Figure 13: Stainless steel oxygen lines from supernumerary

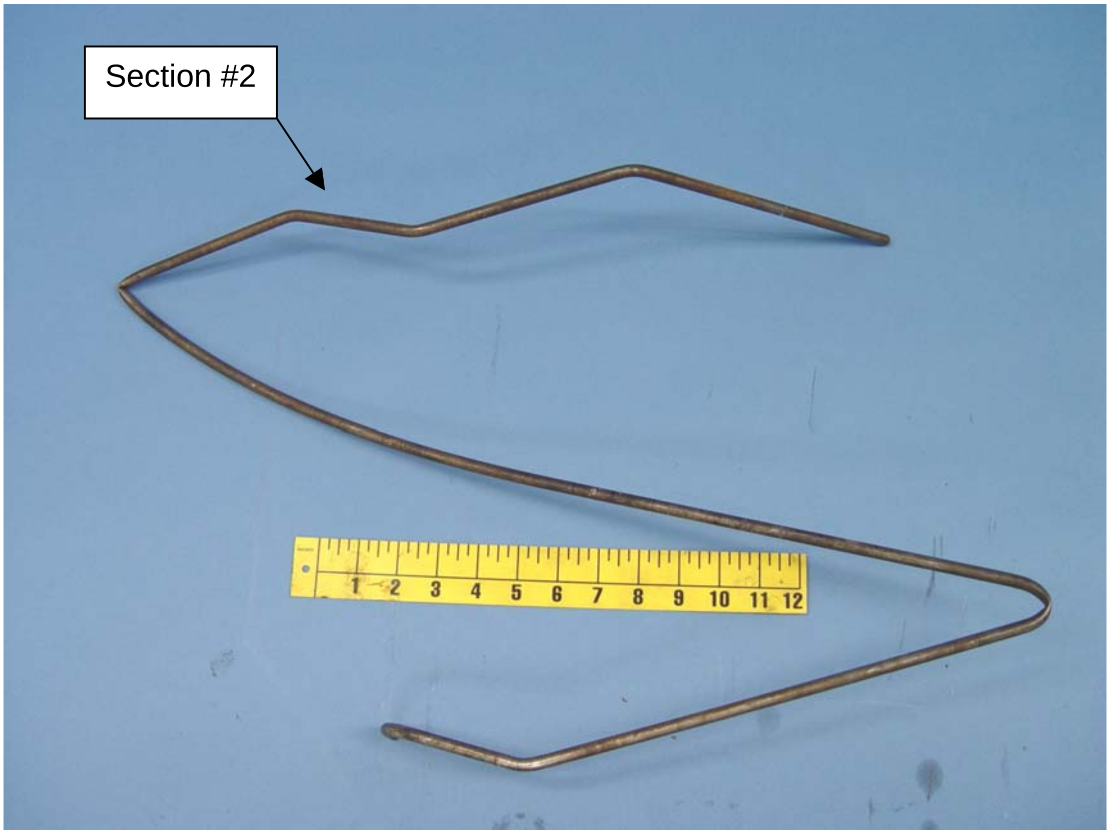

Figure 14: Stainless steel oxygen line from supernumerary

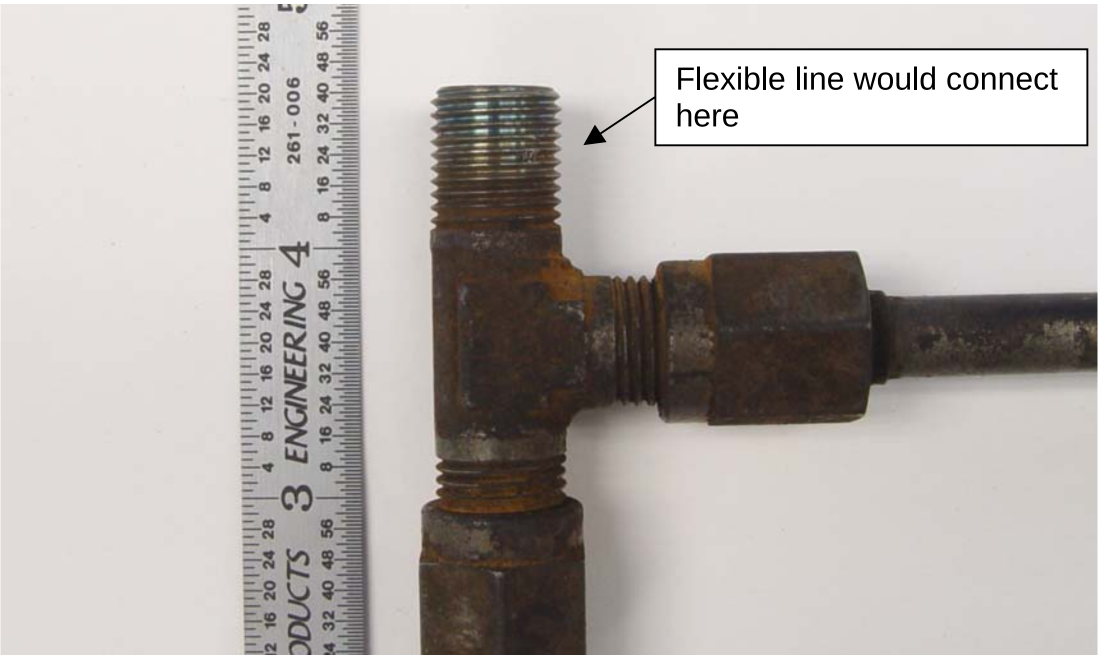

Figure 15: Upstream T fitting from section #4

Figure 16: Middle T fitting from section #4

Figure 17: 90- degree elbow from section #4

Portion of ventilation duct

A portion of an aluminum ventilation duct (figure 18) that would have been located in the overhead of the supernumerary compartment was examined. This portion of the ventilation duct had sustained thermal damage and had areas with a light amount of soot adhering to its surface. Additionally, there were some areas exhibiting clean burn that indicates that the surface had reached a temperature sufficient to burn off the soot at those locations. A hole was observed in this portion of the duct. The hole is where a smaller branch line would have been attached. The area around the hole has evidence that the aluminum duct reached its incipient melting temperature.

Figure 18: Portion of aluminum ventilation duct

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