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

September 19, 1996

METALLURGIST'S FACTUAL REPORT — Report No.96-160

A. ACCIDENT

Place	: East Moriches, New York
Date	: July 17, 1996
Vehicle	: Boeing 747-100, N93119
Operator	: Trans World Airlines (TWA flight 800)
NTSB No.	: DCA96-M-A070
Investigator	: Robert Swaim (AS-40)

B. COMPONENTS EXAMINED

Five components of fuel quantity indicator system.

C. DETAILS OF THE EXAMINATION

Five fuel quantity indicator components were received and examined on October 16 and 17, 1996. Participating parties to the investigation included, Boeing Commercial Airplane Co., Tecstar Inc., Honeywell, and TWA. The items were arbitrarily assigned identification numbers, #1 through #5 and are shown with labels in figure 1.

Item #1.

Item #1 was a complete fuel quantity compensator unit, with wiring and electrical connector. The part was reportedly removed from the right wing tip surge tank A TWA Fuel Tank/Probe Configuration Schematic shows that the right wing tip has a fuel compensator unit, labeled as "F81". One wire marker on the received part was labeled "F80/F81" and another wire marker was labeled "60B40037-322". The part was further labeled "Right Wing" and contained a data plate with "P/N FG6C2, Boeing Spec 60B92010-50, S/N Y-147, Series 1" inscribed.

Item #2.

Item #2 was a short deformed tubular section with a yellow finish. The part measures 5.9 inches in length and 3.3 inches in circumference and marked in handwritten ink as "9-8-96-1 VPL DN".

The configuration including the calculated circular diameter (1.2 inches) and location of the holes were consistent with the engineering drawing of the inner element of a "FG6" fuel quantity system compensator. One "FG6" compensator is installed in each fuel tank of a B747-100 aircraft.

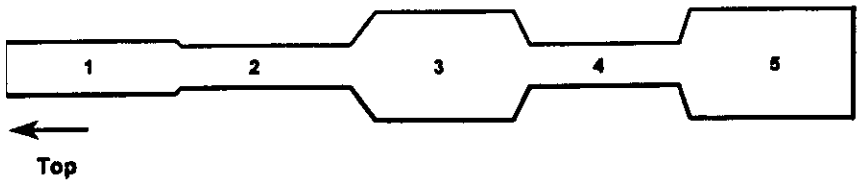
Item #3.

An approximately 14.5 inches long fuel probe was designated item #3. The received component was further identified by a handwritten tag as "8/30/96-23 SM Item #40". Item #3 had been hand delivered to the Materials Laboratory by Bill Tobin of the FBI. The fuel tank probe with pieces of terminal block attached was heavily deformed and crushed and appeared to have been exposed to a fire. One end of the outer tube element had the characters "-106" stamped into it. Honeywell drawing 10022199 identifies a "-106" component as a part of a "FG420A08" fuel probe. The Honeywell Maintenance Data and Operational Flight Data Manual[1] shows that this part number is used only in the #1 and #4 Reserve tanks. TWA Fuel Tank/Probe Configuration Schematic shows that the installed location of the probe would have been the aft outboard position within either the #1R or #4R tanks. It was reported that another fuel probe tagged with the same dash number had been previously examined at Huntsville, Alabama and that it had been removed from the left wing (tank #1R). By inference, item #3 would have been from the right wing (tank #4R).

Item #4.

An approximately 19 1/4 inch long piece of fuel probe was designated as item #4. Item #4 was received with both ends crushed inward and the end caps pushed inward ahead of the crushed ends. The tube was heavily damaged and crushed and bent in two places. No terminal block or wiring was attached.

The outer element was cut open to expose the inner element. Measurements of the outer diameters and lengths and position of colored spacers on the inner element are presented in the illustration and table following.



Drawing illustrating the different diameter sections found on the inner element of item #4. Measured diameters are listed in the table below.

[1]Honeywell Maintenance Data Operations and Flight Data, Fuel Quantity Indicating System 95-4876C-1 dated 15 June 1972

Section	Diameter	Length of Section	Cumulative Distance from Top	Spacer Color
1	0.40+-.01	3.1	3.1	Yellow
2	0.335 to 0.340	6.6	9.7	
3	0.795+-.01	3.7	13.4	White
4	0.36+-.01	3.0	16.4	
5	0.80+-.02	3.5	19.9	

When compared to Honeywell drawing 10022198, sheet 32 the configuration identified the component as part of a "FG420A37" fuel probe. These part number probes are used in the #1 and #4 main fuel tanks. No indications of burning or arcing was noted on either the inner diameter of the outer tube or the outer diameters of the inner element. Approximately half of the urethane coating[2] on the inner element was flaked off.

Item #5.

Item #5 was a 72 inch long piece of fuel probe with a green tag "Z3113" attached. The item was received in two pieces but the systems investigator reported that the probe was originally removed in one piece and that it separated during transit to the materials laboratory. Portions of the terminal block and wiring were attached. One red and two white wires were connected to the terminal block, but no wiring numbers were visible.

Based on the overall length of the probe (72 inches) and the Teflon spacer location and color sequence, item #5 was determined to be a "FG420A13"[3] fuel probe, from the center tank (probe # 3 or 4). The outer tube was bent and crushed in several places with no indications of arcing, burning or sooting. As-received, the inner element of the probe was protruding approximately 2 1/2 inches from the lower end of the outer tube. Normally the inner tube is roughly flush with the end of the outer tube. The inner element was removed in two sections from the outer tube, one from the upper end and one from the lower end. Approximately 7 inches from the lower end there was a bluish black stain

[2] Urethane is applied to the inner element during manufacture as a water repellant. Flaking is reported to be a common condition after usage.

[3] Honeywell drawings 10022199 and 10022198

(approximately 1/2 inch wide and 3/4 inch long) on the exterior of the inner element. In the as-received condition, the position of the stain corresponded to the upper edge of a crushed area of the outer tube. The urethane coating was missing over a large portion of this stain; however, around the periphery of the missing coating the stain was found underneath the coating, consistent with the presence of the stain at the time the coating was applied. The coating surrounding the stain had an irregular appearance consistent with brush application of coating as described as a standard repair method in the Honeywell overhaul manual[4]. Indications of similar brush coating applications were noted at several other locations along the inner element.

The lower end of the outer tube was cut open for about 8 inches from the bottom exposing the inner surface of the outer tube in the area of the previously noted crush and the area corresponding to the original location of the stain on the inner element. The inner surface of the outer tube adjacent to the stained area of the inner element had the as-manufactured yellow finish and showed no stains, pitting or other damage. Nearby areas contained some corrosion and pitting where the mechanical deformation (crushing) had occurred and the surface finish had been breached. A flake of urethane coating was found mechanically attached to the inside surface of the outer tube at the upper end of the crush area. The location of the urethane flake approximately corresponded to the as-received location of the stain area on the inner element. The urethane flake was removed from the outer tube and found to match in shape and size of about 60% to 80% of the missing coating area at the stain on the inner element.

Joe Epperson
Senior Metallurgist

[4] Honeywell Overhaul Manual Fuel Quantity Tank Unit 95-4879C-3, 1 June 1977

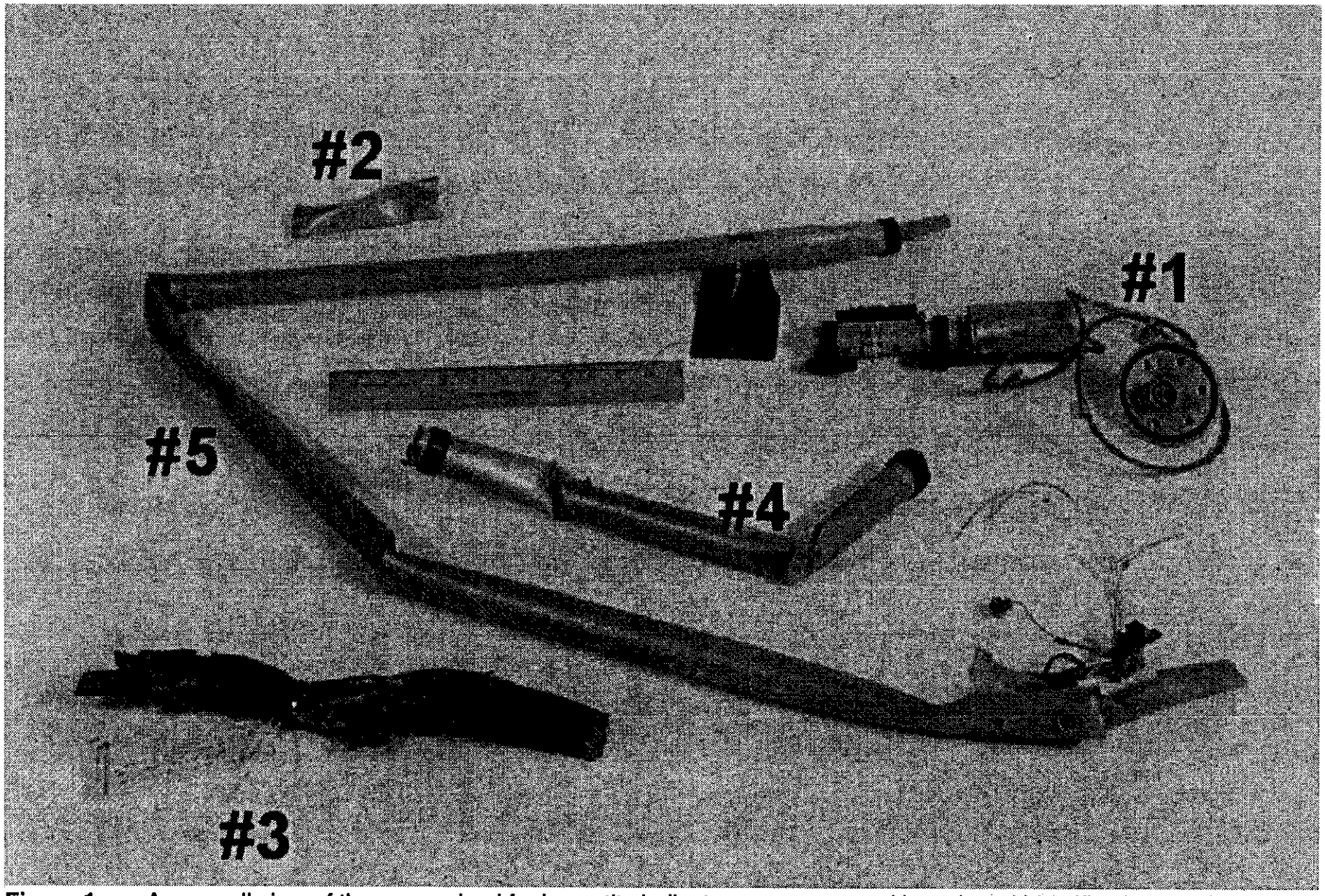


Figure 1 An overall view of the as-received fuel quantity indicator components with assigned identification numbers.