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FACTUAL REPORT ON RED/BROWN SUBSTANCE FOUND ON PASSENGER SEATS

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National Transportation Safety Board

Office of Research and Engineering
Washington, D.C. 20594

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FACTUAL REPORT ON RED/BROWN SHADED SUBSTANCE FOUND IN PASSENGER SEATS

DCA96MA070

A. Accident

Location: East Moriches, New York

Date: July 17, 1996

Time: 2031 Eastern Daylight Time (EDT)

Airplane: Boeing 747-131, N93119
Operated as Trans World Airlines (TWA) flight 800

B. Group

N/A

C. Summary

On July 17, 1996, at about 2031 EDT, a Boeing 747-131, N93119, crashed in the Atlantic Ocean, about 8 miles south of East Moriches, New York, after taking off from John F. Kennedy International Airport (JFK). The airplane was being operated on an instrument flight rules flight plan under the provisions of Title 14 Code of Federal Regulations (CFR), Part 121, on a regularly scheduled flight to Charles De Gaulle International Airport (CDG), Paris, France, as Trans World Airlines (TWA) flight 800. The airplane was destroyed by explosion, fire and impact forces with the ocean. All 230 aboard were killed.

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Introduction

While examining recovered passenger seats, investigators noted that a red/brown shaded substance was present on some mechanically damaged seatbacks. These seats were generally located above the wing center section (WCS) in the C zone of the passenger cabin. The substance was found on seat components located *inside* of the seatback. This substance was not visible on the exterior of the seats; it was only visible if the seatback was damaged or disassembled.

National Transportation Safety Board (NTSB) investigators consulted with Weber Aircraft (the manufacturer of the C-zone seats)[1] to determine if this substance was consistent with materials used to manufacture or repair the seats. Also, NTSB investigators collected samples of seat material containing the substance for chemical testing.

Seatback construction

According to Weber Aircraft's Component Maintenance Manual, Passenger Seat Installation (TWA's specification for the seats), the seatbacks are made of an internal frame, padded cushioning materials, an upholstered cover, and a rigid plastic material which attaches to the aft side of the seatback (see Figure 1 for a drawing of a typical seatback). Many of the seatback components are bonded together with adhesives to form the seatback assembly. The adhesives are applied to the surfaces of the components with a brush or spray application. The type of adhesive used depends on the type(s) of materials that are bonded together and on the availability of the adhesive to the manufacturer or maintenance facility. See Table 1 for examples of adhesives that are used to manufacture or repair the seats.

[1] For information about the cabin interior wreckage documentation, see *Airplane Interior Documentation Group Factual Report*, which is in the public docket.

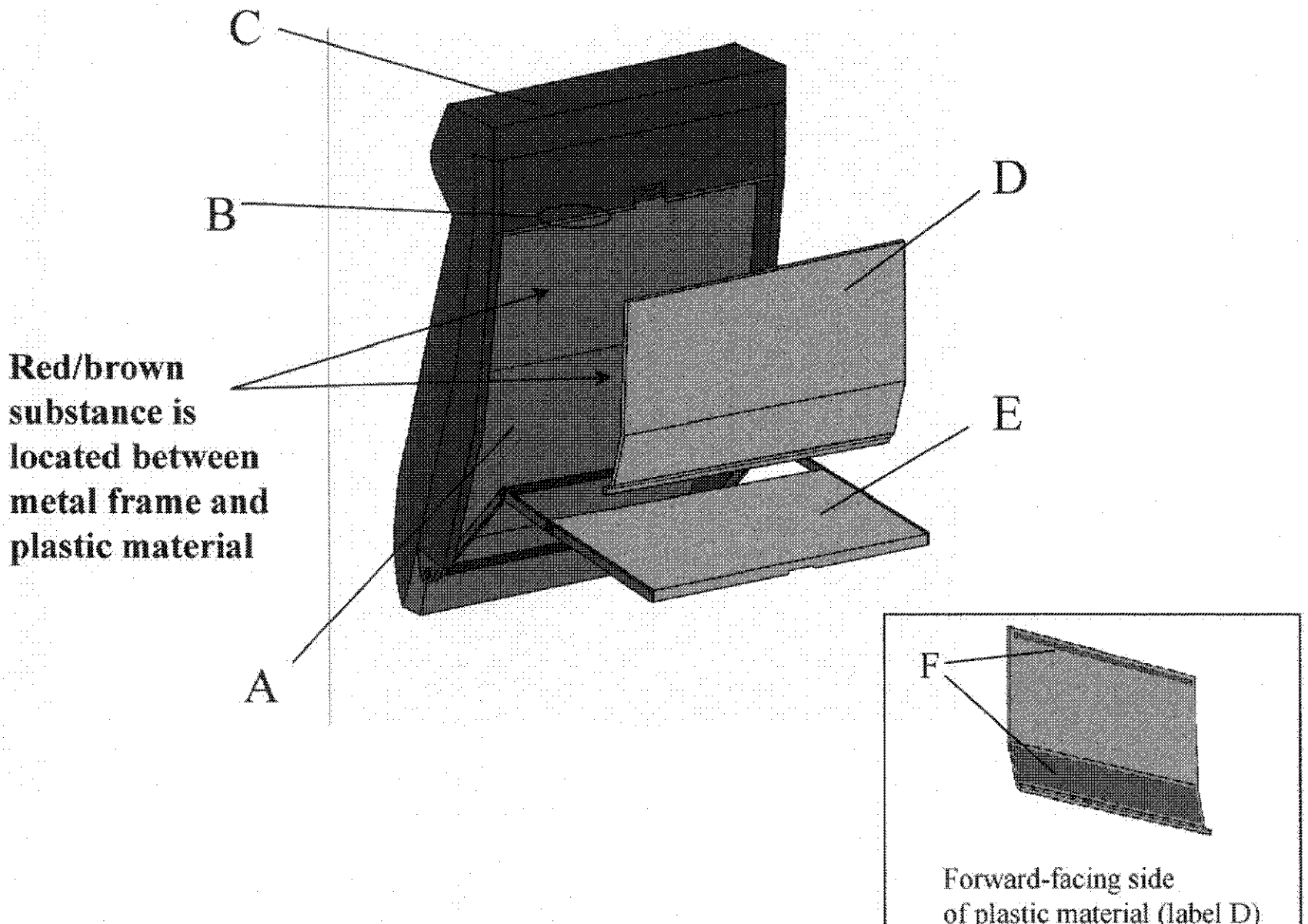

Figure 1. Seatback structures (not to scale).

Product	Manufactur	Color	Adhesive type
N120, N122, N123	Stabond	Reddish/brown or red	Chloroprene
DC-11817	Uniroyal	Yellow	Chloroprene
M6304	Uniroyal	Yellow	Chloroprene
1357	3M	Gray-green	Chloroprene
2141	3M	Yellow	Chloroprene
NS 230	Stabond	Clear or red	Styrene butadiene rubber
A-1404-B	BF Goodrich	Clear	Urethane
2262	3M	Clear	Acrylic/nitrile

Table 1: Adhesives used to manufacture or repair the seatbacks.

The internal seatback frame is made of aluminum (Figure 1, label A). Different types of cushioning material and filler material cover the internal seatback frame including a polyvinyl chloride (PVC) foam and a polyethylene foam. These materials are bonded to the internal seatback frame with adhesives. An upholstered cover (which is typically made of a blend of wool and nylon[2] fabric) is attached to the cushioning materials and the internal seatback frame with adhesive and Velcro® tape.

In the aft side of the seat headrest, sections of foam (Figure 1, label B) are bonded with adhesive to the internal seatback frame. The padded cushioning materials are placed over this foam, and the upholstered cover is placed over the cushioning materials (Figure 1, label C). The Weber Aircraft representative told Safety Board investigators that this foam material in the seats of the accident airplane appeared to be Ethafoam™ (a polyethylene foam) which is manufactured by Dow Chemical Company. These foam sections are bonded to the internal seatback frame with an adhesive.

A rectangular-shaped rigid plastic sheet that forms the external surface of the seatback (Figure 1, label D) is bonded with adhesive to the aft side of the seatback. A pull-down food table (Figure 1, label E) when stowed fits against this plastic material on

[2] According to the FTC, nylon is a generic name for a manufactured fiber in which the fiber-forming substance is a long-chain synthetic polyamide.

the seatback. This plastic material is an acrylonitrile butadiene styrene (ABS) plastic sheet. Flexible foam strips (Figure 1, label F) are bonded with adhesive to this plastic sheet, and these materials are bonded together with adhesive to the internal seatback frame. These strips are used to strengthen the plastic to metal adhesive bond. The Weber Aircraft representative told Safety Board investigators that this foam in the seats of the accident airplane appeared to be a foam material which is manufactured by Rubatex® Corporation. According to the corporation's literature, this material is polyvinyl chloride/acrylonitrile butadiene rubber (PVC/NBR) foam.

According to a representative of TWA, the passenger seats were repaired as necessary, and they were also removed from the airplane and reconditioned about every three to four years. According to TWA's specification for the seats (a revision dated 1978), Stabond N120 was the recommended adhesive to use to repair or recondition the seats. A representative of Stabond Corporation told Safety Board investigators that this adhesive was discontinued about 20 years ago and that it has been replaced by adhesives N122 and N123. These adhesives are neoprene (chloroprene) rubber[3]-based adhesives. Their natural color is reddish/brown, but they also can be made a red color.

Analysis of the red/brown substance

Wreckage examination

Safety Board investigators noted the red/brown shaded substance on seat components *inside* of the seatbacks.[4] This substance was only visible if the seatback was damaged or disassembled; it was not visible on the outside of the seats. It was found on internal seatback components which are normally coated with adhesives. Specifically, the red/brown substance was found on the aft side of the internal seatback frame, on the forward side of the plastic seatback material under the pull-down food tray, and on the foam material between the internal seatback frame and the plastic seatback material. Also, this substance was found on the foam material in the aft side of the seat headrest. It appeared to have been sprayed or brushed onto these materials. The color of the substance was generally red/brown; however, the color varied between light and dark

[3] According to the Federal Trade Commission (FTC), rubber is a generic name for a manufactured fiber in which the fiber-forming substance is comprised of natural or synthetic rubber, including the following category:
A manufactured fiber in which the fiber-forming substance is a polychloroprene or a copolymer of chloroprene in which at least 35 percent by weight of the fiber-forming substance is composed of chloroprene units.

[4] In addition to the red/brown shaded substance, Safety Board investigators also noted a yellow/gold shaded adhesive on internal seatback components. This yellow/gold adhesive was found in addition to the red/brown shaded substance and appears to be a separate application of adhesive.

shades of red and/or brown.[5] Photographs of some seatbacks from the accident airplane appear in Appendix A.[6]

The Weber Aircraft representative examined photographs of seats from the accident airplane. The representative told Safety Board investigators that based on the location and the appearance of the red/brown substance, this substance was an adhesive which is used to assemble or to maintain and repair seat components.

Chemical testing

Safety Board investigators collected samples of the red/brown shaded substance from three different seatback materials: a foam material, a rigid plastic material, and a metal material. These samples were analyzed independently by two laboratories: Materials Science Division, National Aeronautics and Space Administration (NASA), Kennedy Space Center, Florida; and, McCrone Associates, Inc., Westmont, Illinois. Photographs of samples appear in Appendix A.

NASA analysis

Four samples of seat material containing the red/brown substance were analyzed by the NASA laboratory. These samples were analyzed using Fourier-Transform Infrared (FTIR) microscope spectroscopy to identify organic components. The full NASA report appears as Appendix B.

Sample number	Airplane seat location	Material on which the sample was located
67	Row 19, seat 2	foam (Figure 1, label F)
70	Row 17, seat 8	plastic (Figure 1, label D)
73	Row 27, seat 2	plastic (Figure 1, label D)
74	Row 24, seat 7	metal (Figure 1, label A)

Table 2: Samples analyzed by NASA.

Sample number 67 was the foam material bonded to the plastic seatback material. A red shaded substance was on one side of this material, and a darker red shaded substance was on the other side. The foam itself and the substance were analyzed independently. The NASA laboratory determined that the foam material itself was

[5] The shade of the substance appeared to vary with factors such as the thickness of the adhesive application and its exposure to environmental elements.
[6] The labels used to describe the seatback construction in Figure 1 are also used in these photographs.

consistent with a plasticized PVC foam. Their report states that evidence suggested that the substance on each side of the material was the same and that it was characteristic of a resorcinol-based curing adhesive containing a high concentration of dye. Resorcinol products are used in dyes and as a cross-linking agent for neoprene.

Sample number 70 was the plastic seatback material, and a red shaded substance was on one side of this material. The plastic material and the red substance were analyzed independently. The NASA laboratory determined that the plastic material itself was similar to a graft-copolymer of acrylonitrile and styrene on chlorinated polyethylene and that the red shaded substance was characteristic of a polychloroprene-based contact adhesive.

Sample number 73 was the plastic seatback material, and a red/brown shaded substance was on one side of this material. The plastic material and the red/brown substance were analyzed independently. The NASA laboratory determined that the plastic material itself was consistent with a graft-copolymer of acrylonitrile and styrene on chlorinated polyethylene. Their report states that the red/brown substance was a mixture and that its major component was most consistent with a polymethacrylamide.

Sample number 74 was a metal material. A yellow/light brown shaded substance and a black shaded substance were on one side of the material; and, a soot-like substance was on the opposite side of the material. The substances on each side of this metal material were analyzed independently. The NASA laboratory determined that the gold substance was an acrylic polymer and that the black substance was a phthalate resin product (probably a Dacron® filler). The laboratory also determined that the major component of the soot-like material was a zinc oxide which is consistent with an oxidized phase of a zinc based PVC stabilizer.

McCrone, Inc., analysis

Nine samples of seatback material containing the red/brown substance were analyzed by the McCrone, Inc., laboratory. The McCrone, Inc., report appears as Appendix C.

The samples were first examined with a stereomicroscope using magnifications of up to 64X. After this preliminary examination, a sample of foam material with a red shaded substance was examined using a low vacuum scanning electron microscope with energy dispersive x-ray spectrometry (EDS). Both a sample of the red shaded substance and a sample of the foam material itself were analyzed. The laboratory determined that elevated levels of zinc and magnesium were present in the foam sample containing the red substance.

Samples of seatback material were also analyzed using an electron microprobe with EDS. The laboratory determined that elevated levels of zinc and magnesium were present in all but one of the samples.[7] Their report stated that the magnesium could be in the form of a magnesium carbonate or an organo-metallic salt such as magnesium stearate. Their report also stated that the zinc material appeared to be small particles of zinc oxide. These salts are commonly used as fillers in adhesives.

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Chemical Analysis

[7] Carbon and oxygen were the major components of that one sample.