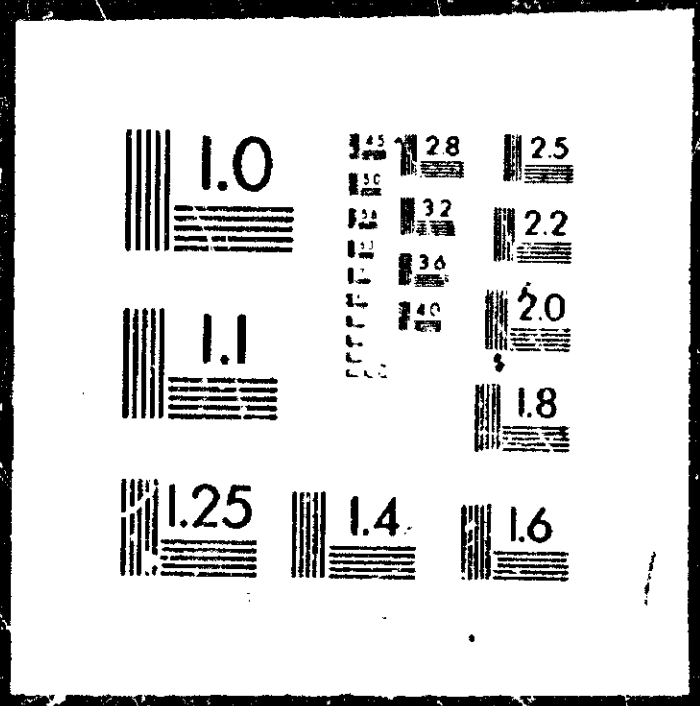
1 OF 1

PB 88
917006



PB88-917006

Hazardous Materials Incident Report In-Flight Fire, McDonnell Douglas DC-9-83, N569AA Nashville Metropolitan Airport Nashville, Tennessee, February 3, 1988

(U.S.) National Transportation Safety Board
Washington, DC

13 Sep 88

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/HZM-88/02	2. Government Accession No. PB88-917006	3. Recipient's Catalog No.
4. Title and Subtitle Hazardous Materials Incident Report--In-Flight Fire, McDonnell Douglas DC-9-83, N569AA, Nashville Metropolitan Airport, Nashville, Tennessee, February 3, 1988		5. Report Date September 13, 1988
		6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 4829A
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D.C. 20594		13. Type of Report and Period Covered Hazardous Materials Incident February 3, 1988
		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract:

On February 3, 1988, American Airlines flight 132, a McDonnell Douglas DC-9-83, departed Dallas/Fort Worth International Airport, Texas, for Nashville Metropolitan Airport, Tennessee. In addition to the passenger luggage in the midcargo compartment, flight 132 was loaded with a 104-pound fiber drum of textile treatment chemicals. Undeclared and improperly packaged hazardous materials inside the fiber drum included 5 gallons of hydrogen peroxide solution and 25 pounds of a sodium orthosilicate-based mixture. While in flight, a flight attendant and a deadheading first officer notified the cockpit crew of smoke in the passenger cabin. The passenger cabin floor above the ceiling of the midcargo compartment was hot and soft, and the flight attendants had to move passengers from the affected area. The captain, who was aware of a mechanical discrepancy with the auxiliary power unit on an earlier flight which resulted in in-flight fumes, was skeptical about the flight attendant's report of smoke. No in-flight emergency was

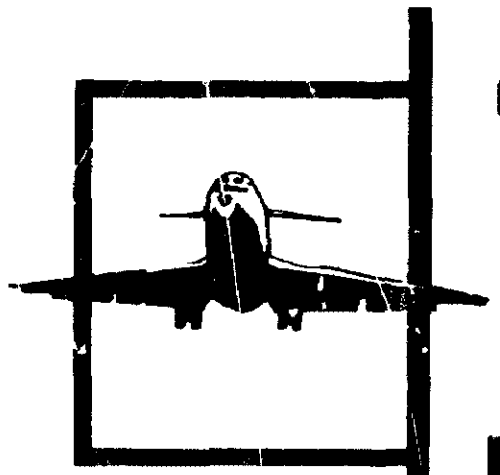
17. Key Words: transportation of hazardous materials, assertiveness training, communication, evacuation, hydrogen peroxide solution, undelcared hazardous materials		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 72	22. Price A04 $15.95

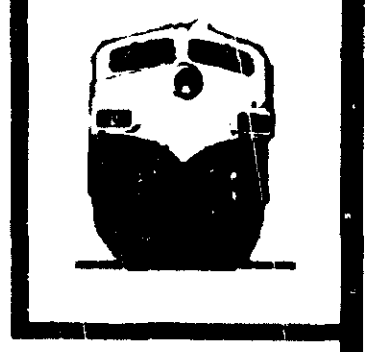
NTSB Form 1765.2 (Rev. 5/88)

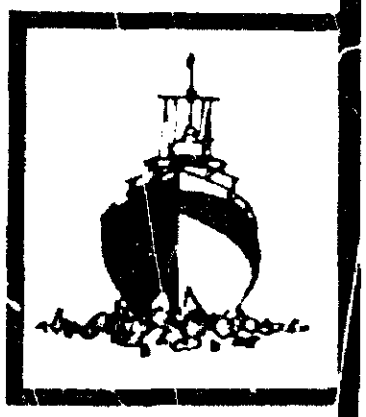
declared. After landing, the captain notified Nashville Ground Control about the possibility of fire in the cargo compartment, and he requested fire equipment. The flight attendants then initiated procedures to evacuate the airplane on the taxiway. Shortly thereafter, the 120 passengers and 6 crewmembers evacuated the airplane. After the plane was evacuated, crash/fire/rescue personnel extinguished the fire in the cargo compartment.

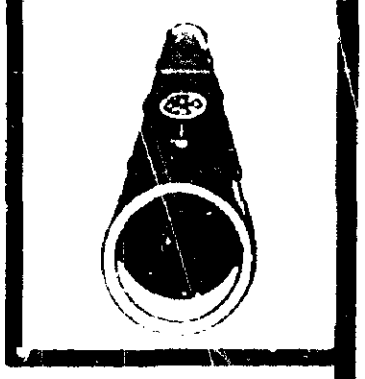
The report discusses several safety issues including the undeclared and improperly prepared hazardous materials, the performance of the cargo compartment, the performance of the flight crew and flight attendants after smoke was discovered, and factors that affected the survivability of the passengers, flightcrew, flight attendants, and ground crew.

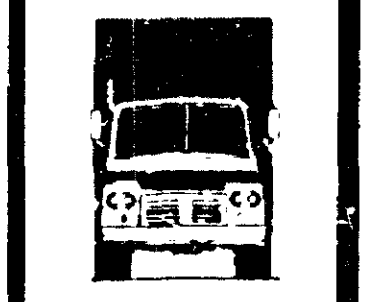
PB88-917006











NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HAZARDOUS MATERIALS INCIDENT REPORT

IN-FLIGHT FIRE,
McDONNELL DOUGLAS DC-9-83, N569AA,
NASHVILLE METROPOLITAN AIRPORT
NASHVILLE, TENNESSEE,
FEBRUARY 3, 1988

NTSB/HZM-88/02

UNITED STATES GOVERNMENT

CONTENTS

EXECUTIVE SUMMARY

On February 3, 1988, American Airlines flight 132, a McDonnell Douglas DC-9-83, departed Dallas/Fort Worth International Airport, Texas, for Nashville Metropolitan Airport, Tennessee. In addition to the passenger luggage in the midcargo compartment, flight 132 was loaded with a 104-pound fiber drum of textile treatment chemicals. Undeclared and improperly packaged hazardous materials inside the fiber drum included 5 gallons of hydrogen peroxide solution and 25 pounds of a sodium orthosilicate-based mixture. While in flight, a flight attendant and a deadheading first officer notified the cockpit crew of smoke in the passenger cabin. The passenger cabin floor above the midcargo compartment was hot and soft, and the flight attendants had to move passengers from the affected area. The captain, who was aware of a mechanical discrepancy with the auxiliary power unit on an earlier flight which resulted in in-flight fumes, was skeptical about the flight attendant's report of smoke. No in-flight emergency was declared. After landing, the captain notified Nashville Ground Control about the possibility of fire in the cargo compartment, and he requested fire equipment. The flight attendants then initiated procedures to evacuate the airplane on the taxiway. Shortly thereafter, the 120 passengers and 6 crewmembers evacuated the airplane. After the plane was evacuated, crash/fire/rescue personnel extinguished the fire in the cargo compartment.

The National Transportation Safety Board determines the probable cause of the in-flight fire to be a chemical reaction resulting from a hydrogen peroxide solution, in concentration prohibited for air transportation, which leaked and combined with the sodium orthosilicate-based mixture from an undeclared and improperly prepared container. The probable cause of the unauthorized transportation was the shipper's lack of knowledge about restrictions and requirements for hazardous materials and inadequate procedures for detecting undeclared hazardous materials shipments. Contributing to the delay in detecting the in-flight fire and the captain's decision not to declare an in-flight emergency was the lack of heat or smoke detection equipment in the cargo compartment and insufficient flightcrew communication. Contributing to the threat to the airworthiness of the airplane was the lack of a fire extinguishment system for the cargo compartment and the inadequate design of the cargo compartment ceiling.

The report discusses several safety issues including the undeclared and improperly prepared hazardous materials, the performance of the cargo compartment, the performance of the flight crew and flight attendants after smoke was discovered, and factors that affected the survivability of the passengers, flightcrew, flight attendants, and ground crew.

HAZARDOUS MATERIALS INCIDENT REPORT

IN-FLIGHT FIRE
MCDONNELL DOUGLAS DC-9-83, N569AA
NASHVILLE METROPOLITAN AIRPORT
NASHVILLE, TENNESSEE
FEBRUARY 3, 1988

1. FACTUAL INFORMATION

1.1 History of the Flight

On February 3, 1988, American Airlines flight 132 (American 132), a McDonnell Douglas DC-9-83, departed Dallas/Fort Worth International Airport, Texas, at 1445[1] destined for Nashville Metropolitan Airport, Tennessee. Operating as a regularly scheduled passenger flight, American 132 had 120 passengers, 4 flight attendants, and 2 flightcrew members aboard.

In addition to passenger luggage, the airplane was loaded with 6,365 pounds of air freight. The air freight included two packages of hazardous materials: a 20-pound cylinder of oxygen and a 104-pound fiber drum of textile treatment chemicals. Hazardous materials inside the fiber drum included 5 gallons of hydrogen peroxide solution, an oxidizer, and 25 pounds of a sodium orthosilicate-based mixture, a granular corrosive solid material.

No labels or markings had been affixed to the fiber drum to indicate that it contained hazardous materials, and the shipping paper did not describe the contents of the drum as hazardous. Both the oxygen cylinder and the fiber drum were loaded into the middle cargo compartment of the airplane, and the fiber drum which had no orientation markings or arrows was laid on its side.

The captain was provided written notice that the 20-pound oxygen cylinder had been loaded on the airplane and he knew its location. The captain was not aware that any other hazardous cargo had been loaded on the airplane.

After departing Dallas/Fort Worth International Airport, American 132 had an uneventful flight until it was on a final instrument landing system approach to Nashville Metropolitan Airport. At 1603:16 (11 min. 6 sec before landing), the "Fasten Seat Belt" sign was illuminated. Shortly thereafter, flight attendant No. 3 performed passenger safety seatbelt checks; she noticed "no odd smells or smoke as reported later." She returned to the front of the airplane and entered the first class lavatory. When she heard several chimes, she exited the lavatory, saw flight attendant No. 1 in the main cabin checking seat rows, and observed that "the [main] cabin was slowly filling with a light smoke."

---

[1]All times herein are central standard time based on the 24-hour clock.

A few minutes before landing, a passenger in seat 17-E saw smoke rising from the floor "through what appeared to be a seam where the carpeting meets the sidewall." He summoned a flight attendant (No. 4), alerted her to the situation, and pointed to a location two rows ahead. At this time, he also noticed a burning electrical smell, but he did not notice if the floor was hot. Flight attendant No. 4 noticed a "haze" and detected an "irritating odor of something burning." At this time, the airplane was descending from 6,000 feet to 4,000 feet.

Flight attendant No. 4 quickly went to the rear of the airplane to call the cockpit crew on the interphone. She told flight attendant No. 2 to get a fire extinguisher and determine the source of the smell. At 1609:06 (5 min. 16 sec. before touchdown), flight attendant No. 4 called the first officer on the interphone and told him, "We've got smoke in the cabin" and " . . . we don't know where it's coming from." (She maintained communications with the first officer throughout the remainder of the flight.)

At 1609:09, Nashville Radar Approach directed American 132 to descend and maintain 2,500 feet.

At 1609:14, the first officer informed the captain, "We got smoke." Flight attendant No. 4 additionally told the first officer, "It's a real bad smell," and the first officer responded that he could now also smell it. At 1609:29, the first officer told the captain, "Smell the smoke--got smoke in the cabin." The captain asked if it was smoke or fumes, and the first officer responded, "Naw, it smells electrical. They can't tell where it's comin' from."

Meanwhile, flight attendant No. 2 had retrieved a water fire extinguisher and proceeded to the problem area expecting to find a smoldering cigarette. She said that after inspecting the area, she "could not find any signs of fire or smoke," and because no one could identify the source of the problem, she obtained a Halon fire extinguisher.

Flight attendant No. 1, who was working the first-class cabin, looked into the main cabin and saw condensation which she assumed was smoke. She responded to the area, removed seat cushions in row 15, and felt the floor "looking for a source of fire." A passenger seated in 16-E also saw smoke rising from the floor and described the smell as fumes "similar to burning plastic or an acid reaction." He said that he told a flight attendant that the smoke was coming from the floor and not the seat.

A passenger seated in 17-B said that after the cockpit crew had announced their approach to the Nashville area, he noticed a haze in the main cabin and looked for someone smoking. When he saw no one smoking, he continued looking for the source of the smoke and saw "smoke rising from a floor vent on the right side of the airplane." A passenger seated in 17-F also reported seeing smoke coming from a vent on the floor in front of him.

An American Airlines first officer, who was in uniform and riding deadhead in the main cabin, said that a flight attendant asked him to help find the cause of heat and fumes that were "emanating from the floor of the cabin compartment." He inspected the area around rows 15 through 18 and reported to the flight attendants that "the floor of the aircraft was hot and the aisle was beginning to soften." He then reported his observations to flight attendant No. 4 and to the cockpit crew via the rear cabin interphone. Passengers in row 18, the area affected most by the hot, soft floor, were moved to other seats.

At 1609:54, the captain again asked the first officer if the problem was "fumes or smoke." At 1610:06, flight attendant No. 4, using the interphone, reported, "[A] pilot said the floor is getting really soft, and he said we need to land." When the first officer asked the flight attendant who was providing her this information, she gave the interphone to the deadheading first officer.

The deadheading first officer identified himself as a (Boeing) 727 first officer and said, "You got the floor back here in the middle dropping out slightly. . . . You have . . . to land this thing in a hurry." The first officer in the cockpit acknowledged the information and said, "We're gettin' it down now," to which the deadheading first officer responded, "Okay, be quick." The first officer in the cockpit acknowledged, "Okay." The deadheading first officer then added "have the trucks meet us." When questioned about the deadheading first officer's recommendation to have the trucks meet the airplane, the first officer in the cockpit told the Safety Board that he must have been putting the interphone hand set away because he did not hear him.

At 1610:30, the first officer told the captain that a first officer in the back reported that the floor was getting soft. The first officer then recommended, "[You] probably ought to drop the gear . . . . There's somethin' going on in the . . . floor board." The airplane was nearing the configuration point,[2] and at 1610:40, the landing gear was lowered.[3]

At 1611:57 (2 min. 25 sec. before touchdown), the captain again asked the first officer, "No smoke, just fumes, right?" The first officer responded, "So far it's just smoke--fumes." At 1612:08, the first officer asked flight attendant No. 4, "Okay, you don't see any smoke--it's just fumes?" She responded, "Bad fumes." He again asked, "Just bad fumes?" Another flight attendant on the front main cabin interphone answered, "Yes." Flight attendant No. 4 then told the first officer, "[It's] startin' to hurt my eyes now." The first officer then told flight attendant No. 4 that he was getting off the interphone and "Call me it anything important changes."

At 1612:35, the captain asked the first officer, "No problems?" The first officer responded, "There's just fumes back there." At 1612:44 the captain said, "We've had fumes before from the APU [auxiliary power unit] . . . where it was at least initially."[4] The APU was not operating at this time.

At 1,000 feet, the first officer asked the captain, "Do you want to have any . . ."; however, he was unable to complete his question because of cockpit landing checklist duties. Ten seconds later (1 min. 11 sec. before touchdown), he again started, "Do you want to call any . . . " when he was interrupted by the captain who said, "We don't have a problem yet, just a few fumes." The first officer said, "You don't smell it?" The captain replied, " Yeah, I smell it."

At 1614:22, the airplane safely touched down on runway 2 left. At 1615:56, the deadheading first officer called the cockpit crew from the forward cabin interphone and informed the first officer "You've got a big problem back here . . . the heat is coming up through the floor." When asked if he saw any smoke, the deadheading first officer answered, "Yes," and added, "We better get outta here." The first officer advised the captain of this information, and the captain decided to evacuate the airplane which was on taxiway T-2. At 1616:43, the first officer notified Nashville Ground Control about the possibility of fire in the cargo compartment, and he requested fire equipment. The flight attendants then initiated procedures to evacuate the airplane on command of the captain. Shortly thereafter, the 120 passengers and 6 crewmembers evacuated the airplane.

After the airplane was evacuated, two American Airlines aircraft maintenance employees approached the captain, who was on the ground near the airplane, and inquired about the problem. They reported that the captain said there was a fire in the cargo area. They opened the aft cargo

---

[2]Configuration point is the point when the landing gear is normally lowered

[3]In a statement later provided to the Safety Board, the captain said that he elected to lower the gear to be sure that it did not become a part of the developing situation.

[4]The captain was aware of a mechanical discrepancy that had been entered in the airplane's log book by the previous flightcrew. The entry described a problem with fumes in the cabin in conjunction with the operation of the APU, and the log noted that a loose fitting on the burner can had been tightened to correct the discrepancy.

compartment and saw very little smoke inside. Then, they opened the midcargo compartment and thick white/grey smoke poured out. They closed the door and reopened it slowly to control the flow of smoke from the compartment. After the door was reopened and before the firefighters arrived, they removed cargo from the compartment; however, after a few pieces of cargo were removed, the door was closed again.

When firefighters arrived at the airplane, the midcargo compartment door was closed. It was reopened again, and firefighters saw thick white/grey smoke but no flames. Water was sprayed into the compartment, and the firefighters observed steam.

A firefighter, in protective breathing equipment, entered the cargo compartment and unloaded cargo until he saw flames in the right rear corner of the compartment. He got out of the compartment and water was sprayed into the aft section of the compartment until there were no visible signs of fire.

1.2 Injuries to Persons

Injuries	Flightcrew	Cabin Crew	Passengers	Others	Total
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	4	9*	5**	18
None	2	0	111	0	113
Total	2	4	120	5	131

*Three passengers were transported to a hospital and treated for injuries incurred as a result of the incident. Six additional passengers provided written statements to the Safety Board describing injuries received as a result of the incident; however, medical records are not available for those six persons.

**Two firefighters and three American Airlines employees.

1.3 Damage to Airplane

Damage to the airplane was limited to the aft 1/3 of the midcargo compartment and the area immediately above the compartment ceiling panels up to and including the cabin flooring. Varying degrees of thermal damage were evident on the aft ceiling, aft right sidewall, and aft bulkhead liners from about Fuselage Station (F.S.) 750 aft to and including the bulkhead liners at F.S. 798. The liners were constructed of S-2 fiberglass cloth reinforced phenolic sheets of varying thickness and met the fire penetration requirements of Special Federal Aviation Regulation (SFAR) 25 Amendment 25-60.

Aluminum support straps were used to attach and interconnect the liners in the compartment. Lateral and longitudinal straps were used on the ceiling and vertical straps on the sidewalls. A section of longitudinal support strap on the ceiling had melted and separated at F.S. 770 which resulted in a gap in the ceiling liners at that location.[5] (See figure 1.)

There was no other extensive thermal damage to the remainder of the ceiling and side wall liners. There was no damage to the cargo compartment floor.

---

[5]Aluminum melts at about 1,200° F.

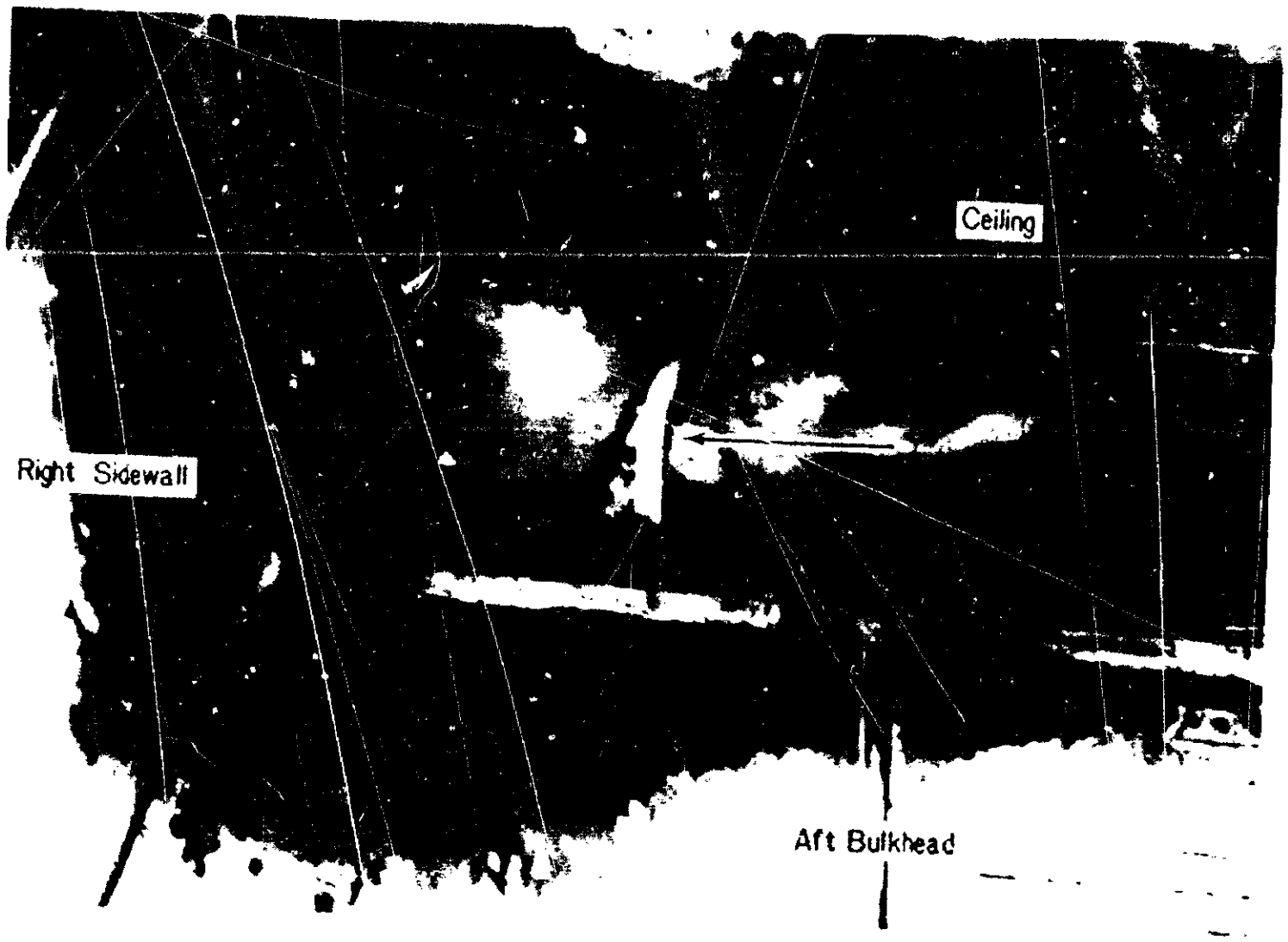


Figure 1.--Fire damage to midcargo compartment. Arrow points to section of the longitudinal support strap which had melted and separated at F.S. 770.

Varying degrees of thermal damage and sooting was evident in the channel between the cargo compartment ceiling panels and the cabin floor. Five lateral floor beams, constructed of 7075T6 aluminum alloy, were exposed to substantial heat that escaped from the cargo compartment. Rockwell B hardness tests were conducted on the beams to determine if the beams were affected, and three of the five beams required replacement due to loss of strength from exposure to heat. Location of the beams replaced were F.S. 750, 769, and 788; beams at F.S.731 and 807 were satisfactory.

The floor panel beneath cabin seats 17D and 18D exhibited thermal damage. A 50-square-inch area of the composite panel, constructed of fiberglass laminations with a Nomex core, was charred. The cabin floor carpet undersurface in this area was also charred and brittle. Other structural damage due to heat included intercostal damage and cargo compartment ceiling support damage. (See figure 2.)

Flight control, engine control, and hydraulic system actuation cables pass longitudinally through the heat-damaged area between the cargo compartment ceiling and the cabin floor. Most of the thermal damage occurred to the cables, cable guides, and fairleads between F.S. 750 and 769. As a safety precaution, 63 system control cables were replaced including 20 flight control, 18 engine control, 18 hydraulic system actuation, and 7 environmental system control cables. Additionally, there was charring of electrical wiring. Sooting was noted on the auxiliary tank fuel vent line at F.S. 693. Total repair costs for the airplane were $228,823.

Figure 2.--Arrow points to charred floor beneath seat 17D.

1.4 Other Damage

Some passenger luggage and air freight in the aft section of the midcargo compartment sustained fire, smoke, and water damage. No dollar estimate is available

1.5 Personnel Information

1.5.1 American Airlines

The captain and first officer were qualified and certificated according to Federal Aviation Administration (FAA) regulations. American Airlines provides cockpit resources management (CRM) training for all of its pilots during their initial training, recurrent training, and captain's duties and responsibilities training sessions. The CRM program reportedly includes lectures, video tape presentations, and group discussions concerning crew interaction, communication, and performance. The captain's most recent exposure to this training was during his recurrent training in January 1988. The first officer's most recent session was during his last annual recurrent training in June 1987.

The flight attendants were trained and qualified in accordance with FAA requirements. The training includes teaching flight attendants to inform the cockpit crew about safety problems and unusual occurrences identified in the passenger cabin. Initial training includes emergency

procedures, crew coordination, and effective communication. Recurrent training includes general safety responsibilities of flight attendants and cockpit crew interactions, including crew coordination and communication. Both initial and recurrent training address fire detection and extinguishers use, cabin fires, classes of fire, and volatile fuel spills and threats. There is no joint training of cockpit and cabin crews.

The fleet service clerk who accepted the fiber drum of textile treatment chemicals had been employed by American Airlines since November 1985. He had been provided basic training courses for his job, including hazardous materials transportation requirements. The FAA-approved training program includes proper packaging, marking, labeling, and documentation of hazardous materials. Additionally, the training program cautions clerks that undeclared hazardous materials may be included in packages offered for transportation. (For information on American Airlines cargo acceptance procedures, see section 1.17.4 of this report.)

1.5.2 Textile Treatments International, Inc.

Textile Treatments International, Inc., (Textile Treatments), of Austin, Texas, was the company that shipped the fiber drum containing undeclared hazardous materials. The company had no written procedures or training requirements for shipping hazardous materials; and, there were no records to indicate that either the person who packaged or the person who offered the shipment for transportation had any hazardous materials transportation training. However, Textile Treatments had prepared a product safety data sheet for the sodium orthosilicate-based mixture (Textreat S-W); the product safety data sheet identified fire, explosion, reactivity, and health hazard information. For information on the hazards of the materials packaged in the fiber drum, see section 1.17.1 of this report.

The person who packaged the textile treatment chemicals in the fiber drum had been a production manager for a commercial laundry operation, and he had previously held supervisory positions in the textile manufacturing industry. He held a bachelor's degree in business administration and an associate degree in industry management.

The person offered the fiber drum to American Airlines for transportation had a work history in marketing and sales. He held a bachelor's degree in mechanical engineering and a masters of business administration with emphasis in industrial management.

1.6 Aircraft Information

The airplane, a DC-9-83, was manufactured by the McDonnell Douglas Company and delivered to American Airlines on July 13, 1987. It was assigned registry number N569AA.

The airplane and engines had about 2,007 hours of flight time. There were no known maintenance problems with the airplane when it left Dallas/Fort Worth International Airport. The previous flightcrew had entered a mechanical discrepancy in the airplane's log book concerning a problem with fumes in the cabin in conjunction with the APU operation. The log noted that a loose fitting on a burner can had been tightened to correct the problem.

The lower fuselage cargo compartments of large passenger airplanes, i.e., not accessible to crewmembers during flight, are classified in accordance with Title 14 Code of Federal Regulations 25.857 as class C or class D type compartments. Class C compartments must have "a separate approved smoke detector or fire detector to give warning at the pilot or flight engineer station" and "an approved built-in fire-extinguishing system controllable from the pilot or flight engineer stations."

This airplane was equipped with three class D cargo compartments located in the lower portion of the fuselage. Class D cargo compartments require no fire/smoke detection or fire extinguishing systems. Instead, class D cargo compartments depend on the limited availability of oxygen in the compartment to suppress a potential fire. The midcargo compartment has a volume of about 400 cubic feet. It is 21.5 feet long, beginning at F.S. 541 and continuing to F.S. 798.

At the time the DC-9-80 series was certified in August 1980, the maximum permissible size of the class D compartment was 2,000 cubic feet; current regulations restrict maximum size to 1,000 cubic feet. The policy at the time of certification of the DC-9-80 series for class D cargo compartments required the sum of the compartment volume and the leakage rate of air per hour to be less than 2,000 cubic feet. Specifically, a midcargo compartment with a volume of 400 cubic feet was permitted a maximum air leakage rate of 1,600 cubic feet per hour. The lining material was required to pass vertical and 45° Bunsen or Tirrill burner tests as outlined in SFAR 25.853 and 25.855.

In addition to size and leakage rate requirements, SFAR 25.857 defines a class D compartment as one that meets the following requirements:

> A fire occurring in it will be completely confined without endangering the safety of the airplane or its occupants.
>
> There are means to exclude hazardous quantities of smoke, flames, or other noxious gasses from any compartment occupied by the crew or passengers.
>
> Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits.
>
> Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane.

During the certification process, the FAA determined that McDonnell Douglas met the requirements for compartment liner material and all sections of SFAR 25.837. Leakage rate compliance was demonstrated by flight test.

1.7 Meteorological Information

The 1500 surface weather map, prepared by the National Weather Service, showed a large high pressure area just northeast of Lake Superior and a cold front extending from a small low over northern Delaware southwest through southwestern Virginia, along the North Carolina-Tennessee border and into central Mississippi. Nashville,Tennessee, was in the northerly flow about 100 miles northwest of the front.

Surface weather observations for the Nashville Metropolitan Airport were as follows:

> 1550--measured ceiling 1,000 feet overcast; visibility--4 miles; weather--fog; temperature--53°F; dew point--50°F; wind--10° at 4 knots; altimeter setting--30.08 inches Hg.
>
> 1648--measured ceiling 1,000 feet overcast; visibility--4 miles; weather--fog; temperature--53°F; dew point--50°F; wind--290° at 5 knots; altimeter setting--30.09 inches Hg.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

There were no known radio communications difficulties. At 1616:43, the first officer asked Nashville Ground Control to call out fire equipment because of the possibility of some fire in the cargo compartment. At 1616:53, Nashville Ground Control advised American 132 that it had acted as requested.

1.10 Aerodrome Information

The Nashville Metropolitan Airport, elevation 599 feet, is 6 miles from downtown Nashville, Tennessee. The airport is certificated for commercial operations in accordance with 14 CFR Part 139.

The landing area consists of three runways, runway 31/13 which is 8,500 feet long and 150 feet wide, runway 2L/20R which is 7,702 feet long and 150 feet wide, and runway 2R/20L which is 4,305 feet long and 150 feet wide.

1.11 Flight Recorders

The airplane was equipped with a Fairchild model A-100A cockpit voice recorder (CVR), Serial No. 52020. It was removed from the airplane and taken to the audio laboratory of the Safety Board for analysis.

The CVR recording starts at 1545:34 when the airplane is starting its descent into the Nashville Metropolitan Airport. A transcript (see appendix B) was prepared of the final 8 minutes of the 30-minute recording. The transcript starts at 1608:28 just before the flightcrew was first notified about smoke in the cabin. Electrical power is removed from the CVR at 1617:14 just after the emergency evacuation notification was given.

The flight data recorder was not removed from the airplane for laboratory examination because it was not applicable to this incident.

1.12 Wreckage and Impact Information

Not applicable.

1.13 Medical Information

Three passengers were transported to a local hospital for treatment. One passenger had had open heart surgery 7 days before the incident. He reported pain in the chest incision and right leg following the evacuation. He was admitted overnight for chest pain, smoke inhalation, and trauma to legs. This patient's wife, also a passenger, was admitted overnight for smoke inhalation observation. A third passenger, who had recently undergone back surgery, was treated for back pain following the evacuation and released.

Two firefighters and three American Airlines ground crew employees were treated for smoke inhalation; one firefighter was hospitalized and released the following day. The four flight attendants were taken to the hospital for smoke inhalation and eye irritation; they were treated and released.

Additionally, six passengers who were not treated on scene later reported injuries as a result of the incident. Three passengers reported coccyx or back injuries as a result of the evacuation. Three passengers reported treatment for smoke inhalation injuries.

1.14 Fire

No flames were seen while the airplane was in flight. On approach to the Nashville Metropolitan Airport, the passenger cabin floor on the right side and center aisle near row 18 was hot and soft, and smoke was observed rising from the floor near row 15. Odors described primarily as burning electrical insulation were detected in both the passenger cabin and the cockpit.

After the first officer notified the Nashville Ground Control about the possibility of fire, the Nashville Ground Control notified the Nashville Metropolitan Airport Office of Safety and Security. It dispatched 14 personnel and 6 vehicles, 2 quick response units, and 4 crash fire rescue units to the airplane. The vehicles had 12,500 gallons of water available, 100 to 120 gallons of which were used. Additionally, 500 pounds of aqueous film forming foam (AFFF) and 1,500 pounds of dry chemical were available but not used.

After the initial efforts by firefighters to extinguish the fire with water, a firefighter reentered the cargo compartment and unloaded cargo from the right aft section to reach the area where he had observed flames. As he approached the right rear area, he found that some boxes had been charred. In the right rear corner of the compartment, he found a fiber drum lying in its side, and when he attempted to remove the drum, it came apart. He noticed that it contained a white powder, one large plastic bottle, and two smaller bottles. He pulled the drum to the door and kicked it out of the airplane. (See figure 3.) Cargo which had been loaded near the drum was extremely hot, therefore, the firefighter sprayed the area with water to cool it. The firefighter then exited the compartment because of fatigue.

Figure 3.--The fiber drum after it was removed from the airplane.

A second firefighter, not wearing protective breathing equipment, entered the midcargo compartment to finish removing the freight. However, he was soon overcome by fumes and had to be pulled from the cargo compartment.

While the firefighters initially sprayed water into the cargo compartment, another firefighter entered the passenger cabin and saw four or five American Airlines employees inside the airplane collecting carry-on baggage. None of the employees were wearing fire protection gear or breathing equipment. The firefighter inspected the inside of the airplane and saw no fire, but he said that the cabin was "very, very hot." He described the floor as very hot, melting in the vicinity of row 16, and sticky where someone had pulled up the carpeting. He then heard someone yell that the fire was spreading, and everyone left the airplane.

Shortly after exiting the airplane, he and another firefighter went back inside the airplane to cut a hole in the floor to inspect the space beneath it for fire. The firefighters made a hole approximately 4 inches in diameter; however, no fire was found.

1.15 Survival Aspects

The captain ordered an unplanned evacuation of the airplane at 2 minutes 8 seconds after touchdown. Evacuation slides at the two forward cabin doors, the aft galley door, and the tail cone were deployed without incident. The overwing emergency exits were not used. Passengers in rows 1 through 15 exited through the forward two exits. Most passengers in rows 16 through 32 exited through the two rear exits.

No instructions or announcements about the unplanned evacuation were made to passengers using the airplane's public address system. During the evacuation, flight attendants shouted all commands to passengers. Passengers were instructed to "Unfasten seatbelts. Come this way. Remove shoes. Don't take anything with you."

While several passengers said that they did not hear the flight attendants' commands to remove shoes until they were near exits, most reported that the evacuation was orderly. Some delays in evacuating the plane occurred when passengers retrieved personal belongings to carry off the plane and when passengers did not hear instructions to remove their shoes until reaching the exits.

The American Airlines policy is to require passengers to remove shoes before jumping on evacuation slides to prevent punctures to the slides. However, instructions to remove shoes and to leave personal belongings behind during emergency evacuations are not included on passenger safety information cards. (See appendix C.)

The American Airlines *In-Flight Manual*, Section 60, *General Emergency Procedures*, establishes the procedures for flight attendants during an emergency situation. American Airlines instructs its flight attendants to use the public address system when time is available before landing to give passengers instructions about emergency evacuations. However, when unplanned emergency evacuations are necessary, procedures require flight attendants to shout commands and never to delay the evacuation to obtain megaphones.

1.16 Tests and Research

The Safety Board requested the FAA Technical Center in Atlantic City, New Jersey, to provide technical assistance in replicating and measuring the reactions of materials shipped in the fiber drum. Additionally, the FAA Technical Center was requested to conduct fire and heat penetration tests on the cargo compartment liners.

1.16.1 Hazardous Materials Tests and Research

Numerous tests were conducted to evaluate the reaction of materials shipped in the fiber drum that was in the midcargo compartment of the airplane. The first tests involved pouring 50 percent hydrogen peroxide solution on fiberboard. There was no charring, fire, or measurable exothermic reaction.[6]

The next series of tests involved combining 50 percent hydrogen peroxide solution and the sodium orthosilicate-based mixture. Copious amounts of foam, steam, and oxygen were produced. Additionally, the combination of the two materials produced an exothermic reaction when 1/2 the amount of material (1/2 scale) similar to what had been transported was tested; the maximum temperature was 220°F. Neither the laundry booster nor the liquid brightener that also were packaged in the fiber drum had any effect on the chemical reaction which resulted when hydrogen peroxide and the sodium orthosilicate-based mixture were combined during tests.

Several small scale tests were performed combining 50 percent hydrogen peroxide solution, the sodium orthosilicate-based mixture, and small corrugated cardboard boxes. The sodium orthosilicate-based mixture was placed on an aluminum surface and a small cardboard box was placed over it. The cardboard box had been previously wet with the hydrogen peroxide solution (although not selected for that reason) and had dried. The hydrogen peroxide solution was then added to the sodium orthosilicate-based mixture. About 2 minutes later, smoke was observed coming from the box. Portions of the box then turned black, glowed red, and finally broke into flames. The test was repeated several times using cardboard boxes that had not been previously wet with the hydrogen peroxide solution. However, while elevated temperatures and some slight charring were experienced, no flames were produced.

Another series of tests involved soaking small cardboard boxes with 50 percent hydrogen peroxide solution and allowing them to dry. The sodium orthosilicate-based mixture was placed on an aluminum surface and covered with one of the boxes. About 3 seconds after the hydrogen peroxide was added, smoke was visible; about 5 1/2 seconds later, the box burst into flames. The test was repeated with the sodium orthosilicate-based mixture on a glass surface instead of aluminum. About 10 seconds after the hydrogen peroxide solution was added, smoke was observed; flames, although not as intense, were observed about 12 seconds later.

The tests were then repeated twice using 35 percent hydrogen peroxide solution and aluminum surfaces for both tests. Although exothermic reactions were detected, no ignition or charring of the boxes were evident as in tests conducted with 50 percent hydrogen peroxide solution.

Several larger scale tests were conducted to assess if the quantity of materials had any affect on the reactions. In an 1/2 scale test, 12 1/2 pounds of the sodium orthosilicate-based mixture and about 2 1/2 gallons of 50 percent hydrogen peroxide solution were used. The fiber drum was positioned on its side, and when the materials were combined, foam, steam, and oxygen were generated.

---

[6] A chemical reaction which is accompanied by the liberation of heat.

Although there was an exothermic reaction, no charring or flames were evident. The test was conducted at 1/4 scale with similar results.

Two additional 1/2 scale tests were conducted using fiber drums that had been wet with the hydrogen peroxide solution. One-half gallon of the hydrogen peroxide solution was poured into each fiber drum. The fiber drums were rotated periodically to wet the side walls, but otherwise, they were positioned upright, bottom side down. The hydrogen peroxide solution was permitted to soak into the drums and evaporate; the drums were then dried. One fiber drum was wet using 50 percent hydrogen peroxide solution, and 50 percent hydrogen peroxide solution was used in the test. Less than 2 minutes after the hydrogen peroxide solution and the sodium orthosilicate-based mixture were combined in the drum, it ignited. The entire bottom of the drum was consumed by flames; however, the remainder of the drum was intact. (See figure 4.) The second fiber drum was wet using 35 percent hydrogen peroxide solution, and 35 percent hydrogen peroxide solution was used in the test. While an exothermic reaction was produced in the 35 percent hydrogen peroxide solution test, no fire resulted.

In summary, ignition and flaming were experienced only in tests when the cardboard boxes or fiber drums were presoaked with 50 percent hydrogen peroxide and dried before the tests. Presoaking cardboard boxes or fiber drums in 35 percent hydrogen peroxide did not produce ignition in tests, and cardboard boxes or fiber drums not prewet did not ignite or flame.

Figure 4.--Bottom of test fiber drum was consumed by fire after the fiber drum was presoaked with 50 percent hydrogen peroxide solution, dried, and then exposed to a 50 percent peroxide solution and sodium orthosilicate-based mixture.

1.16.2 Cargo Compartment Liner Tests

Undamaged ceiling and sidewall liners from the airplane were subjected to flame-test requirements in SFAR 25.853, Appendix F, Part III. Both the sidewall liner (.033 inch thick) and the ceiling liner (.019 inch thick) were exposed to a 1,700° F flame for 10 minutes instead of the required 5 minutes. Both liners passed the fire test satisfactorily. The highest temperature recorded 4 inches above the ceiling panel liner was 400° F after almost 10 minutes. The temperature at 8 inches above the liner never reached 200° F, and the temperature 12 inches above the liner never exceeded 180° F.

1.17 Additional Information

1.17.1 Hazardous Materials Cargo

Two packages of hazardous materials were on board American 132. One package was a cylinder of oxygen, compressed gas, net weight--0.45 kilogram. The cylinder of oxygen was not involved in the incident.

The second package of hazardous materials was a fiber drum overpack that contained four different materials, two of which were hazardous materials. The fiber drum contained 5 gallons of hydrogen peroxide solution, an oxidizer; 25 pounds Textreat S-W (sodium orthosilicate-based mixture), a solid corrosive material; 25 pounds of laundry booster; and 24 ounces of liquid brightener. The materials were to be used in a textile treatment demonstration. The fiber drum was approximately 29 inches high and 20 inches in diameter; its gross weight was 104 pounds.

The fiber drum had no markings or labels affixed to it to identify the materials contained inside, to identify the hazards of the materials, or to indicate proper orientation for positioning the package. The only information provided on the outside of the fiber drum by the shipper was the name and address of the company.

The hydrogen peroxide solution (H_2O_2) was packaged in a 5-gallon nonvented Department of Transportation Specification 34 (DOT-34) polyethylene drum. (See figure 5.) It had been filled from one of two 55-gallon drums at the shipper's facility. One of the drums contained 35 percent (weight percent) hydrogen peroxide and the other contained 50 percent hydrogen peroxide. Both 55-gallon drums were marked with the proper DOT shipping name and oxidizer labels. (See figure 6.) The shipper could not conclusively determine which concentration of hydrogen peroxide was put into the 5-gallon drum; 35 percent hydrogen peroxide is normally used in the company's textile treatment process. According to the Manufacturing Chemists Association Chemical Safety Data Sheet SD-33, hydrogen peroxide may present the following hazards:

> Hydrogen peroxide is nonflammable, but it is a strong oxidizer and if allowed to remain in contact with readily oxidizable organic materials it may cause spontaneous combustion. It is a high energy chemical that is decomposed easily by many common catalysts such as heavy metals, ordinary dirt, dust, and enzymes, in a strong exothermic reaction. Liberated oxygen will promote the burning of combustible materials. Practically all solid combustible materials contain sufficient catalytic impurities to decompose hydrogen peroxide rapidly. In concentrations above 65 percent there is insufficient water present or formed to remove heat of decomposition by vaporization. Under conditions favorable for evaporation, fires can be caused by hydrogen peroxide below 65 percent since the peroxide may concentrate as it evaporates. Furthermore, detonation hazards may exist when hydrogen peroxide is mixed with organic materials.

Figure 5.--Damaged 5-gallon polyethylene drum used to transport the hydrogen peroxide solution.

Figure 6.--A 55-gallon drum of hydrogen peroxide at the shipper's facility.

A manufacturer's material safety data sheet for the 50 percent hydrogen peroxide provides the following information:

> Unusual fire and explosion hazards--This product may cause a fire if it drys on clothing, wood, or other combustibles. Contact with flammable liquids or vapors may cause immediate fire or explosion, especially if heated, or it may result in a delayed explosion. Decomposition will release oxygen which will increase the explosive limits and burning rate of flammable vapors.

The Textreat S-W is a sodium orthosilicate-based mixture that is a white-flaked alkaline product consisting of primarily sodium metasilicate and sodium hydroxide ($NaSiO_3 \cdot 2NaOH$). It is marketed by the shipper as a textile treatment product and is regulated for transportation as a solid corrosive material. It is used for processing industrial laundry. When mixed with water, it will generate a mild exothermic reaction; however, when mixed with oxidizing agents like hydrogen peroxide, it can catalyse strong exothermic reactions. Additionally, the sodium orthosilicate-based mixture will react with aluminum and other sensitive metals to produce hydrogen gas. It weighs about 75 pounds per cubic foot and was packaged by placing 25 pounds of the material into a plastic bag (three layers thick). The plastic bag was then placed into the fiber drum with the hydrogen peroxide. The sodium orthosilicate is received from the manufacturer in 100-pound, 250-pound, and 400-pound fiber drums. The packages received are marked with the proper DOT shipping name, corrosive solid, n.o.s.,[7] and with corrosive labels affixed.

The laundry booster is a white powder. The primary ingredient is soda ash (sodium carbonate Na_2CO_3). It does not display any transportation hazard characteristics and is not regulated as a hazardous material. The laundry booster was packaged for transportation by placing 25 pounds of product into a plastic bag (three layers thick). The plastic bag was then placed into the fiber drum overpack with the other materials.

The brightener is a mixture of diethylene glycol, triethanolamine, urea, and a fluorescent brightener. It is a clear, stable, odorless liquid. It has no known transportation hazard characteristics, and it is not regulated as a hazardous material. Two 16-ounce plastic bottles were filled with the liquid brightener at the shipper's facility, one full and the other half full. The bottles were sealed with snap-on type lids, secured with tape, and placed into the fiber drum overpack with the other materials.

1.17.2 Hazardous Materials Shipper Information

Textile Treatments shipped the fiber drum involved in the incident aboard American 132. Textile Treatments was incorporated in Texas on August 21, 1987. It was established to market a chemical treatment process for "stone-washing" blue jeans without using stones. The process requires using Textreat S-W, which is the only material marketed by Textile Treatments. Other materials packaged in the fiber drum were needed to demonstrate the textile treatment process and are not marketed by the company. Both the person who packaged and the person who offered the fiber drum for transportation traveled to Tennessee and intended to use the materials shipped to demonstrate the textile treatment process to a potential customer.

Textile Treatments purchases Textreat S-W from a manufacturer and provides the product to buyers in the original packaging. The original packaging was marked and labeled in accordance with DOT requirements. Truckload quantities of the material are shipped directly to buyers from the

[7] N.o.s. is a transportation industry abbreviation for "not otherwise specified."

manufacturer's facility. Before the incident aboard American 132, Textile Treatments had shipped only one container of Textreat S-W to a customer; however, samples of the product used for marketing demonstrations had been transported in luggage in airplanes at least 10 times by the Textile Treatment representatives.

1.17.3 Tendering of the Hazardous Materials Shipment to the Air Carrier

About 1400 on February 2, 1988, the shipper entered the American Airlines freight office in Austin, Texas, and told the fleet service clerk that he had an item he wanted to ship to Nashville, Tennessee. The American Airlines fleet service clerk gave him a blank air waybill, and after entering the shipper's name, address, and instructions to "Hold at AA air fgt for pick up," the shipper returned the air waybill to the clerk.

The shipper and the fleet service clerk then went to the shipper's car to get the package. The fiber drum was sitting upright in the trunk of the shipper's car. Both men lifted the drum from the car, and the clerk rolled the drum on its bottom rim to the warehouse scale. The clerk described the fiber drum as old and appeared to have been reused several times. He said it had no "eye catching" hazardous materials labels, and he saw no orientation arrows.

The clerk said that when he asked the shipper what was in the drum, the shipper answered "laundry equipment." Another American Airlines freight clerk who was nearby said that he heard the shipper describe the contents of the drum as laundry equipment. However, the shipper told the FAA that when he was asked what was in the drum, he said, "Laundry chemicals for a demonstration outside of Nashville." The shipper said that he was asked nothing else about the contents of the shipment.

The clerk weighed the drum and entered the weight and a hand written description of the contents on the air waybill. The clerk entered the description of the contents as "laundry Q" which he later described as an abbreviation for laundry equipment. The shipper then signed the air waybill certifying that the information contained on the air waybill was correct. (See appendix D.) The certification states ". . . that insofar as any part of the consignment contains hazardous materials/dangerous goods, such part is properly described by name and is in proper condition for carriage by air according to applicable national government regulations . . . ."

After the shipper left, the clerk entered information about the shipment into a computer. Later a printed air waybill was prepared from information stored in the computer about the shipment. The computer-generated air waybill described the shipment as "LAUNDRY EQUIP." (See appendix E.)

The fiber drum remained on the scale for about 1 hour before being loaded onto a cart and taken to an airplane. The cart was left near the airplane, and the driver gave the crew chief the freight manifest. The fiber drum was then loaded on American 574 at Austin, Texas, destined to Dallas/Fort Worth International Airport. It was the only piece of freight loaded on the airplane, and the crew chief believes that it was loaded into a cargo compartment in an upright position.

The fiber drum arrived at the Dallas/Fort Worth International Airport without incident at 1640 on February 2, 1988. It remained there until it was loaded onto American 132 on February 3, 1988. The fiber drum was placed on its side in the right-aft section of the midcargo compartment of the airplane, adjacent to the right side wall and the aft wall of the compartment and below passenger seats in row 18 of the main cabin. A large heavy box containing electronic communications equipment was loaded immediately left of the fiber drum, and cardboard boxes were placed immediately above it.

The fleet service clerk who accepted the fiber drum is a native of Puerto Rico. He speaks English well, but he does have a Spanish accent. The shipper suggested that the clerk may have entered the abbreviation "Q" on the hand written air waybill as an abbreviation for the word "quimica," the Spanish word for chemicals. Because of the possible confusion, American Airlines reviewed the air waybills prepared by that freight service clerk for a 6-month period. No evidence of Spanish words or abbreviations were identified.

The shipper arrived at the American Airlines freight office in Nashville about 0745 on February 3, 1988, to pick up the fiber drum. He was told that it had not arrived, but that it should arrive about 1620 that afternoon on American 132. When the shipper returned to pick up the fiber drum, he learned that his fiber drum had been involved in an incident aboard the airplane.

1.17.4 Regulations for Transporting Hazardous Materials by Air

The DOT regulations governing the preparation and air transportation of hazardous materials are contained in 49 CFR 100-199.[8] Hazardous materials may also be prepared and transported under the International Civil Aviation Organization (ICAO) *Technical Instructions For The Safe Transport of Dangerous Goods By Air*. Generally, the DOT regulations and the ICAO instructions are similar-- both prohibit shippers from offering and carriers from accepting hazardous materials for transportation that are not properly prepared and identified. There are no substantial differences between the DOT and ICAO requirements that would have affected the preparation and transportation of the hazardous materials aboard American 132.

The transportation of 50 percent hydrogen peroxide solution is prohibited in any quantity aboard both passenger and cargo-only aircraft. Thirty-five percent hydrogen peroxide solution is allowed on passenger-carrying aircraft; however, the maximum net quantity in one package is limited to 1 quart. The maximum net quantity of 35 percent hydrogen peroxide solution allowed in one package on a cargo-only aircraft is 1 gallon.

The packaging requirements for hydrogen peroxide solution are contained in 49 CFR 173.266. Specification 34 (DOT-34) polyethylene drums may not be used for air transportation of 35 percent hydrogen peroxide solution. Those packages must have vented closures to prevent accumulation of internal pressure, and vented packagings are not permitted aboard aircraft.

The proper DOT shipping name for the sodium orthosilicate-based mixture is corrosive solid, n.o.s. The maximum net quantity of corrosive solid, n.o.s. allowed in one package on passenger-carrying aircraft is 25 pounds. The maximum net quantity of corrosive solid, n.o.s. allowed in one package on cargo-only aircraft is 100 pounds.

The packaging requirements for corrosive solids, n.o.s. are contained in 49 CFR 173.245b. A variety of packagings are permitted including fiberboard boxes (with plastic bags) or fiber drums.

Title 49 CFR 173.6 prohibits a shipper from offering for transportation aboard an aircraft an overpack containing hazardous materials that require segregation under 49 CFR 175.78. Section 175.78 prohibits packages containing hazardous materials that might react dangerously with one another to be stowed in an aircraft next to each other or in a position that would allow a dangerous interaction in the event of leakage. Oxidizers and corrosives are considered by that regulation to be incompatible.

---

[8]Multimodal hazardous materials regulations, contained in 49 CFR 100-199, are promulgated by the DOT's Research and Special Programs Administration (RSPA).

Title 49 CFR Part 172 requires any person who offers hazardous materials for transportation to properly describe the materials on a shipping paper, including the proper shipping name of the material, hazard class, and quantity. Additionally, the shipper must certify that hazardous materials offered are properly described, packaged, marked (including the proper shipping name of the material and orientation markings for liquid hazardous materials), labeled, and within the limitations prescribed for passenger-carrying or cargo-only aircraft.

Title 49 CFR 175.25 requires passenger-carrying air carriers to display a notice to passengers "concerning the requirements and penalties associated with the carriage of hazardous materials aboard aircraft" as either checked baggage or carry-on articles. The notice must be "prominently displayed"[9] at each location at an airport where the operator issues tickets, checks baggage, and maintains aircraft boarding areas. The notice must contain specific language and must be printed in lettering of at least 3/8 inch high for the first three paragraphs and 1/4 inch high for the last three paragraphs. Size and color of the notice are optional. No similar notice is required to be displayed at freight acceptance areas for passenger carriers or at freight acceptance areas for cargo-only air carriers.[10]

Title 49 CFR 175.33 requires that the operator of the aircraft provide the pilot-in-command written information about hazardous cargo as early as practicable before departure. The written notice must include the proper shipping name, hazard class, and identification number of each hazardous material; the total number of packages and their location aboard the aircraft; the net quantity or gross weight of each package, as applicable; confirmation that the package must be carried on cargo aircraft only if its transportation aboard passenger-carrying aircraft is forbidden; and, confirmation that no damaged or leaking packages have been loaded on the aircraft.

1.17.5 American Airlines Cargo Acceptance Procedures

American Airlines will accept only limited hazardous materials at its passenger service counters. Those include wheelchairs with wet cell batteries, limited quantities of dry ice, limited quantities of ammunition, and personal items such as perfume and health care products. Customers offering other hazardous materials are referred to a separate air freight cargo counter. A $25 per shipment surcharge is assessed for domestic hazardous material shipments, and a $40 surcharge is assessed for most international hazardous material shipments.

Packages offered at the passenger ticket counter that are not declared to contain hazardous materials are treated like passenger baggage. Acceptability is based on size, declared contents, and the condition of the package. Packages that are not sealed or that are obviously leaking are refused. A 90-minute passenger service personnel dangerous goods training course teaches employees to identify packages with hazardous materials labels and to use good judgment to screen undeclared hazardous materials. No checklist or visual aids are used to question customers about the contents of packages offered to identify undeclared hazardous materials.

The American Airlines air cargo freight office has some general acceptability requirements for any packages offered. Clerks are asked to determine the nature of the goods, if the packages meet size, weight, and durability requirements, and if special orientation or other handling requirements are necessary. However, while the carrier uses a detailed checklist procedure (see appendix F) to determine if packages with declared hazardous materials meet all safety requirements, checklist

---

[9]"Prominently displayed" is not defined in the regulations and no written guidelines are available for the use by Federal inspectors when determining compliance with this regulation.

[10]The FAA has drafted and submitted to the RSPA a request to amend 49 CFR 175.25 to require that notices be displayed at all air freight acceptance facilities; however, the regulation has not been amended as of this date.

procedures are not used to determine if general freight packages contain undeclared hazardous materials. Customers are not routinely questioned about undeclared hazardous materials unless a clerk detects something suspicious, that is, a leak, odor, or temperature variance. Subsequent to the incident aboard American 132, American Airlines warned its clerks that some commoditics offered for shipment with general descriptions may contain dangerous goods, and a list of commodity descriptions and potential hazards was provided to the clerks.

Although not required by the FAA, American Airlines posts a notice in cargo freight offices to warn shippers about hazardous materials restrictions. The notice in the Austin office is approximately 9 inches high by 11 inches wide, the lettering meets minimum size requirements for passenger check-in areas, and it is typical of notices posted throughout the carrier's cargo system. (See figure 7.) The notice is attached to a wall at the end of the customer service counter about eye level, about an arms length away, and on the customer's immediate right (approximately 90°) when the customer faces the freight service clerk behind the counter.

A similar notice is also displayed at passenger ticket counters as required by the FAA. In Austin, the notice was posted at the end of the counters between passenger service agents, about thigh high, and where passengers usually place baggage to be checked for flights. Others notices, that is, the prohibition of weapons aboard aircraft, are posted adjacent to the hazardous material restriction notice.

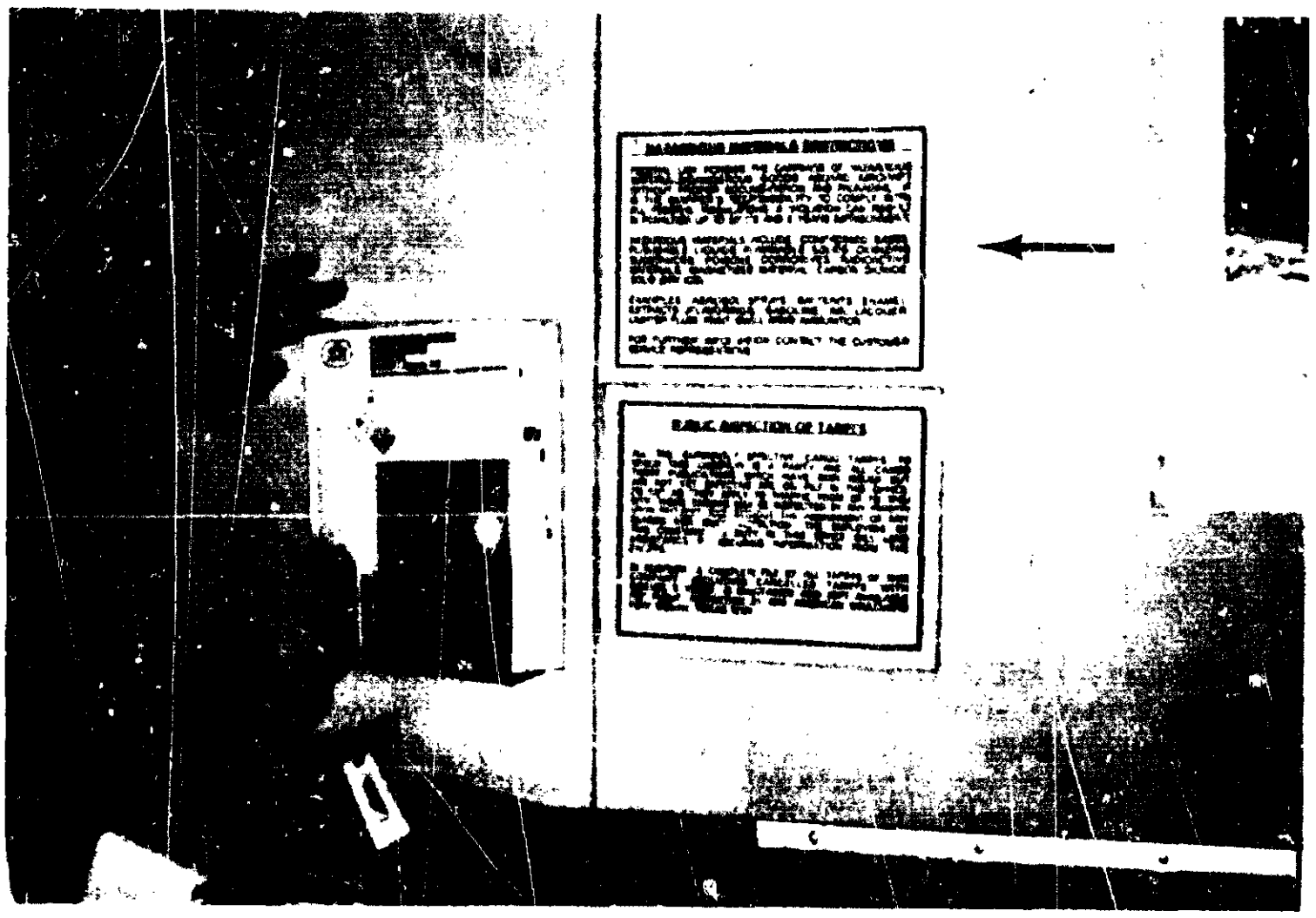


Figure 7.--Hazardous materials restriction notice posted on the wall in the American Airlines air freight office in Austin, Texas.

2. ANALYSIS

2.1 General

The airplane was certificated, equipped, and maintained in accordance with Federal regulations. The flightcrew was qualified and certificated properly, and the flight attendants were qualified for the flight in accordance with Federal requirements. The hazardous materials involved in the incident were not packaged, marked, labeled, or declared in accordance with the DOT or ICAO requirements. Accordingly, the Safety Board directed its investigation to the undeclared and improperly prepared hazardous materials; to the ignition and propagation of the fire; to the performance of the cargo compartment; to the performance of the flightcrew and flight attendants after smoke was discovered; and to factors that affected the survivability of the passengers, flightcrew, flight attendants, and groundcrew

2.2 Hazardous Materials

There was no conclusive evidence to establish the concentration of the hydrogen peroxide solution because there was no sample of the hydrogen peroxide solution available after the incident, and Textile Treatments could not identify the concentration of the hydrogen peroxide solution shipped. However, laboratory tests conducted to determine the compatibility of materials shipped in the fiber drum and the consequences that would result if the hydrogen peroxide solution was released resulted in fires only when 50 percent strength hydrogen peroxide solution was used; no fire, charring, or smoke resulted when identical tests were conducted using 35 percent strength hydrogen peroxide solution. The Safety Board concluded that the 5-gallon polyethylene drum packed inside the fiber drum contained 50 percent strength hydrogen peroxide solution.

Although the hydrogen peroxide solution is a strong oxidizing material that may cause spontaneous combustion if allowed to remain in contact with organic materials, fire resulted during laboratory tests only when the sodium orthosilicate-based mixture and 50 percent strength hydrogen peroxide solution were combined in containers presoaked with 50 percent strength hydrogen peroxide solution. These test results suggest that 50 percent strength hydrogen peroxide solution leaked from the 5-gallon polyethylene drum and wet the fiber drum, dried, and leaked a second time again wetting the fiber drum. An exothermic reaction between the hydrogen peroxide solution and the sodium orthosilicate-based mixture in contact with the fiber drum then caused a fire in the midcargo compartment of the airplane. This conclusion is supported by the location of the fiber drum in relation to damaged components of the airplane; the orientation of the fiber drum, on its side rather than upright, on American 132; the damage to the fiber drum and its contents; and the lack of any evidence to indicate that the fire was initiated elsewhere.

During the investigation, the Safety Board determined that the hazardous materials shipped in the fiber drum did not comply with the DOT safety regulations for several reasons.

- Fifty percent strength hydrogen peroxide solution, in any quantity, is forbidden aboard passenger-carrying aircraft. Even 35 percent strength hydrogen peroxide solution is restricted to a maximum quantity of 1 quart per container for passenger-carrying aircraft.

- The hydrogen peroxide solution, an oxidizer, and the sodium orthosilicate-based mixture, a solid corrosive material, are not compatible and should not have been packaged together.

- While DOT-34 polyethylene drums may be used for 35 percent or 50 percent strength hydrogen peroxide solution, the drums must be equipped with vented closures to prevent the accumulation of internal pressure. However, had it been vented it would have been prohibited aboard aircraft.

- Neither proper shipping names nor hazard class information for hazardous materials packaged inside the fiber drum were marked on the outside of the fiber drum.

- Proper package orientation information was not marked on the outside of the fiber drum overpack to instruct handlers to keep the package upright.

- Hazardous materials warning labels were not affixed to the outside of the fiber drum.

- The shipper did not describe the materials and their hazards properly on shipping papers provided to the air carrier.

In addition to proper packaging of hazardous materials, the safe transportation of hazardous materials depends on sufficient information to identify the materials and the hazards presented during transportation. Accordingly, both shippers and carriers have a responsibility to determine if materials offered for transportation are hazardous and are in proper condition to ensure their safe transportation. Textile Treatments not only failed to provide a proper description of the hazardous materials on the shipping paper, but also failed to provide a description of the contents to American Airlines that would have alerted the carrier that the package contained hazardous materials. Both the hand-written and the typed shipping documents indicated that the shipper told the air carrier that the fiber drum contained laundry equipment, not chemicals. There is no factual evidence to support the shipper's contention that he told the freight clerk that the fiber drum contained laundry chemicals. Had he done so, the word "chemicals" should have alerted the air carrier to the possibility of hazardous materials.

It is likely that the materials were improperly packaged, marked, and described due, in part, to the shipper's ignorance about the regulations governing the transportation of hazardous materials. Even though the shipper may not have been aware of specific Federal transportation regulations, both the person who prepared and the person who offered this shipment for transportation should have been aware of the hazardous characteristics of the materials shipped and recognized the need to package the materials safely and to identify these materials to American Airlines. Hazardous materials labels and shipping descriptions were affixed to containers in the plant for both the hydrogen peroxide solution and the sodium orthosilicate-based mixture from which the shipped materials were taken. These warnings should have been sufficient to have caused the shipper to have determined that precautions were required when shipping these hazardous materials by air.

Although the nature of Textile Treatments' business requires it to ship a hazardous material to its customers and to ship hazardous materials for marketing demonstrations, it has no program to train persons responsible for shipping and handling hazardous materials. Consequently, the Safety Board urges Textile Treatments to establish and implement a hazardous materials transportation safety training program for all persons responsible for packaging, shipping, or transporting hazardous materials.

American Airlines procedures for accepting packages that contain declared hazardous materials are thorough and include detailed checklist procedures to determine if hazardous materials shipments meet all safety requirements. While the Safety Board is convinced that American Airlines would have rejected the fiber drum had it been identified correctly as containing hazardous

materials, the Board believes that American Airlines procedures for accepting ordinary freight packages are not adequate. These procedures do not include routine inquiries about the possibility that hazardous materials may be included but not identified as such. Instead, freight clerks question customers about the possibility of hazardous materials only if an unusual circumstance, such as an odor, temperature differential, or leak, is detected, or if a shipping description clearly indicates that a package may contain hazardous materials.

Following this incident, American Airlines issued a freight services advisory to its freight service personnel to advise them that "commodities tendered for shipment that have a broad general description may contain dangerous goods which are not apparent," and it urged personnel to use logic and good common sense when accepting freight shipments. Included in the list of commodity descriptions are breathing apparatus, chemicals, cylinders, dental apparatus, electrical equipment, instruments, laboratory equipment, and pharmaceuticals. In addition to the advisory, the Safety Board urges American Airlines to develop checklist procedures and questions designed to help freight clerks to identify undeclared hazardous materials offered by general freight shippers who are unaware of Federal hazardous materials transportation safety regulations.

The Safety Board found no statistics to identify the total number of shipments offered for air transportation each year that were found to contain undeclared hazardous materials. However, by reviewing incident reports filed with the DOT, the Safety Board was able to identify hazardous materials incidents that involved undeclared hazardous materials. Between 1971 and March 1988, there were 2,260 hazardous materials incident reports involving air transportation filed with the DOT. Forty-two of these incidents resulted in two or more injuries or more than $10,000 property damage; 22 of the 42 incidents involved undeclared hazardous materials. Additionally, a review of the DOT data for January 1980 through March 1988 disclosed that 1,091 reports were filed for air transportation incidents. Nine of the 1,091 incidents resulted in fires or explosions; 8 of the 9 fires or explosions involved undeclared hazardous materials.

One of the incidents reported above was strikingly similar to the incident that occurred in Nashville, and it involved an undeclared shipment of hazardous materials for transportation through an air freight forwarder. The shipment involved 12 1-gallon containers of 35 percent hydrogen peroxide solution packaged in overpack containers. The hydrogen peroxide solution was also shipped for use in a demonstration, and no hazardous materials were declared on the shipping papers. Instead, the shipping papers described the contents of the packages as "ceiling cleaning solution and equipment." Furthermore, no hazardous materials markings or labels were affixed to the outside of overpacks to warn cargo handlers about the hazardous contents. The shipment originated in Pompano Beach, Florida, on October 31, 1986, and the destination was the Philippines. On November 6, 1986, in Seattle, Washington, cargo handlers found several packages in the shipment soaked with liquid and subsequently determined that 1 to 2 gallons of hydrogen peroxide had leaked from inner containers. Shipper representatives later said that they were unaware of hazardous materials transportation safety requirements when they offered the cargo to an air freight forwarder for transportation.

Industry also has recognized that undeclared hazardous materials present a problem. The International Air Transport Association dangerous goods regulations (Section 1.6.3) address precautionary measures against hidden hazards in cargo and baggage. It notes that experience has shown that shippers using some descriptions to declare the contents of their packages must be asked to check their consignments against the class definitions in the regulations and to confirm that the contents are not restricted.

Following a series of misdeclarations of freight, Swissair imposed new requirements on shippers who describe consignments in generic terms--shipping descriptions must include the phrase "not restricted." Unless the additional description is included with the shipping name, the cargo is assumed to contain hazardous materials.

While the DOT regulations require air passenger carriers to inform passengers about hazardous materials restrictions by posting a notice at locations where tickets are issued, baggage checked, and aircraft boarded, there are no requirements that notices be posted at freight counters where air cargo is offered to air carriers or to air freight forwarders. While American Airlines also posts this notice at freight counter locations, other passenger carriers and cargo-only carriers do not. The Safety Board believes that the DOT should require hazardous materials restriction notices be posted at all air transportation freight acceptance facilities, including the facilities of air freight forwarders.

However, even when the notices are posted, the Safety Board has found the warnings to be inadequate. DOT regulations require the notices to be "prominently displayed" and the lettering to be printed on a background of contrasting color. Instead, notices are often posted at the sides of passenger ticket counters or at other locations that do not readily attract the attention of the public, and they are usually printed in black and white. The notices do not use bright, multiple colors or illustrations to attract the public's attention. In a safety study on passenger safety education,[11] the Safety Board noted that the visual attractiveness of information materials is important if the message is to be noticed and then read. Therefore, the Safety Board believes that in order to increase the effectiveness of the warning notices, air carriers should improve the design, content, and posted location of hazardous materials restriction notices. Additionally, the FAA should develop guidelines for use by persons inspecting air carrier facilities to determine if notices are "prominently displayed," and when found not properly displayed, require corrective action.

The Air Transportation Association of America (ATA) documented problems involving undeclared shipments of hazardous materials in mail accepted by the U.S. Postal Service and which resulted in subsequent incidents in the air transportation system. It asked the U.S. Postal Service to take action to strengthen its hazardous materials program to reduce the number of packages accepted that contain undeclared hazardous materials. The ATA suggested that the U.S. Postal Service revise its regulations governing the acceptance of packages containing hazardous materials; that postal clerks at post office counters question customers to determine if packages contain undeclared hazardous materials; and that the U.S. Postal Service initiate a public awareness campaign using posters and handout materials to educate postal customers about restrictions governing hazardous materials.

In conjunction with its request, the ATA provided information to the U.S. Postal Service about similar actions already taken by the *Australia Post*. To address the problem of undeclared hazardous materials, the *Australia Post* produced training films to teach postal clerks how to identify packages that may contain undeclared hazardous materials and how to question customers about the contents of packages. Additionally, the ATA provided an *Australia Post* poster and handout material designed to educate customers about hazardous materials that should not be mailed. Both the poster and the handout use bright colors and illustrations to attract the attention of customers and to deliver the message. (See figure 8.) The U.S. Postal Service agreed with the ATA suggestions, has revised its hazardous materials regulations, and has initiated employee training and public awareness programs. The public awareness program will include newly designed, multiple-color posters and handout materials to attract the attention of postal customers.

---

[11]Safety Study--*Airline Passenger Safety Education: A Review of Methods Used to Present Safety Information* (NTSB/SS-85/09)

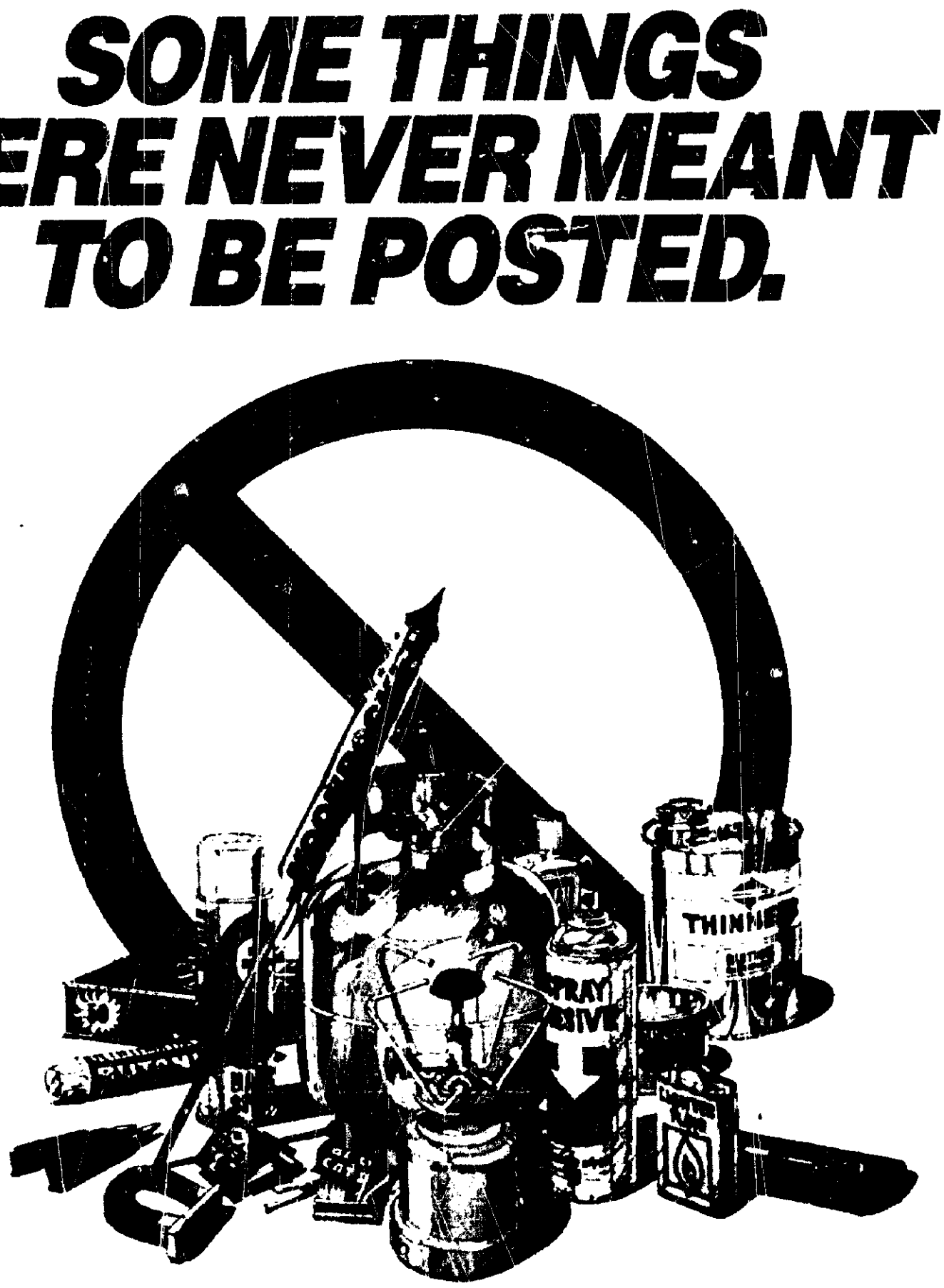


Figure 8.--*Australia Post* hazardous materials information poster designed to attract the attention of customers and to inform customers about materials that must not be mailed.

However, the ATA has not recommended that its members take actions similar to recommendations it has made to the U.S. Postal Service. Because the Safety Board found the American Airlines procedures for accepting general freight packages and for identifying undeclared hazardous materials to be typical of other passenger and cargo air carriers, the Safety Board believes that the ATA should assist its member air carriers in the development of an improved public education and awareness program, assist its members in designing warning notices to attract the attention of shippers, and encourage its members to question customers, including air freight forwarders about the possibility of hazardous materials in general freight packages.

2.3 Airworthiness of Airplane and Cargo Compartment Performance

The airworthiness of the airplane was threatened by fire in the midcargo compartment. Temperatures in the compartment, although localized, were hot enough to melt a section of the ceiling liner aluminum support strap and to cause ceiling liner phenolic resin to cook off. As a result, heat penetrated a breach in the ceiling of the cargo compartment and threatened the safety of the airplane. Although the Safety Board was not able to determine when excessive heat first penetrated the cargo compartment, crewmembers knew the passenger cabin floor above the breached area was hot and soft several minutes before landing. Excessive temperatures reached critical flight, engine, and hydraulic system control cables, floor beams, and the passenger cabin floor. Therefore, the Safety Board concludes that the cargo compartment failed to meet the intent of 14 CFR 25.857(d) and that the potential for a catastrophic in-flight fire existed.

Because the cargo compartment was not equipped with fire or smoke detection systems, the cockpit crew had no way of detecting the threat to the safety of the airplane until smoke and fumes reached the passenger cabin. After smoke was detected in the passenger cabin, the cockpit crew had no means to identify the location of the fire. Furthermore, because the cargo compartment was not equipped with a fire extinguishment system, the cockpit crew had no means available to extinguish or suppress the fire in the cargo compartment. Without fire detection or suppression systems, the cockpit crew must rely on the adequacy of cargo compartment designs and construction to control a fire in the cargo compartment.

The Safety Board participated in the investigation of the accident involving a Saudia Lockheed L-1011 at Riyadh, Saudi Arabia, on August 19, 1980, in which an in-flight fire resulted in the deaths of all 301 passengers and crew aboard the airplane after it landed safely. The probable cause of the accident was determined to be an in-flight fire in a class D cargo compartment. Although the cargo compartment was equipped with an operative smoke detector device, the cargo compartment was not equipped with a fire extinguishment system. As a result of its participation in the investigation, the Safety Board issued Safety Recommendations A-81-12 and -13 to the FAA on February 10, 1981:

A-81-12

Reevaluate the "Class D" certification of the L-1011 C-3 cargo compartment with a view toward either changing the classification to "C," requiring detection and extinguishing equipment, or changing the compartment liner material to ensure containment of a fire of the types likely in the compartment while in-flight.

A-81-13

Review the certification of all baggage/cargo compartments (over 500 cu. ft.) in the "D" classification to ensure that the intent of Title 14 Code of Federal Regulations 25.857(d) is met.

In its recommendations to the FAA, the Safety Board noted several instances of fire in checked baggage from the ignition of matches and other items. In most cases, the fires ignited while the aircraft were on the ground and the aircraft were not damaged. However, the Safety Board raised the possibility of such a fire while in flight and questioned the capability of class D compartments to contain a fire by "snuffing" it to keep it from spreading.

In June 1983, the FAA Technical Center completed a project to study experimentally the effectiveness of transport aircraft class D cargo compartments in containing fires through oxygen starvation. The study concluded that the Federal regulations did not ensure adequate burn-through resistance of class D cargo liners subjected to realistic fires. It noted that the cargo compartment liner is the initial fire barrier for the protection of aircraft components, structure, passenger, and crew from a fire inside the cargo compartment, and it noted that because of cabin exhaust ventilation airflow around the cargo compartment, an opening, rupture, or burn-through of any portion of the cargo liner could feed a cargo fire with large quantities of air. The report warned that some cargo compartments, although primarily lined with fiberglass, have aluminum components and that the use of aluminum may nullify the fire containment capability of burn-through resistant cargo compartment liners.

Subsequently, on August 8, 1984, the FAA issued a notice of proposed rulemaking, Notice 84-11, that addressed the problem of fire containment in cargo compartments by specifying a new test method for determining the flame penetration resistance of compartment liners. When the Safety Board provided comments on the rulemaking on October 9, 1984, it advised the FAA that while proposed flame penetration test methods are more stringent than previous ones, a fire should not be allowed to persist in any state of intensity in an airplane without the knowledge of the flightcrew and that a fire detection system should be required for class D cargo compartments.

On May 16, 1986, the FAA issued a final rule to amend fire safety standards for cargo or baggage compartments to become effective June 16, 1986. The final rule adopted more stringent cargo liner burn-through tests and smaller class D cargo compartments, but it rejected a requirement for fire detection systems in class D cargo compartments.

Furthermore, cargo compartment fire protection research and testing did not consider what effect hazardous materials involvement in a cargo fire could have on the capability of a cargo compartment to contain an in-flight fire. The FAA concluded in its final rule that the effects of hazardous materials were beyond the scope of its rulemaking notice. However, the Safety Board believes that the incident aboard American 132 clearly demonstrates that hazardous materials involvement in a cargo compartment fire must be considered in all cargo compartment fire penetration safety standards; hazardous materials determined to present unacceptable threats should be prohibited.

Safety Recommendation A-81-12 was classified "Closed--Acceptable Action" on November 2, 1982, following a commitment by U.S. air carriers to improve the fire containment capability of the cargo compartment by replacing Nomex fabric cargo compartment ceiling liners with fiberglass. Because of the improved cargo liner flame penetration test requirements and the new restrictions limiting the size of class D compartments, Safety Recommendation A-81-13 was classified "Closed-- Acceptable Action" on August 11, 1986.

The Safety Board urges the FAA to require fire detection and extinguishment systems in all class D cargo compartments; to review the certification of all types of cargo compartments to identify any aluminum or other components that fail to meet thermal protection requirements at least equal to cargo compartment liner thermal protection requirements; to consider the effects of hazardous cargo involvement in fires in all types of cargo compartments; to require that safety deficiencies identified be corrected; and to immediately evaluate prohibiting the transportation of oxidizers in

present class D cargo compartments, and determine if other classes of hazardous materials should also be excluded from present class D cargo compartments. Adding these safety systems to class D cargo compartments will provide even greater protection than is presently provided by class C cargo compartments.

2.4 Operational Factors

The review of the CVR and crew interviews indicates that a deficiency in communication occurred between the cockpit and cabin crews during the in-flight fire and the descent into Nashville. An examination of the dialogue among crewmembers suggests that the captain was skeptical about the flight attendant's initial report of smoke. The first officer also appears to have been reluctant initially to accept that smoke, rather than fumes, was in the airplane.

Given the acknowledged seriousness of in-flight fire and the obvious association of a report of smoke in the cabin with a strong possibility of a fire, the Safety Board is deeply concerned by the captain's apparent reluctance to accept either the flight attendant's or deadheading crewmember's report as valid or to seek additional information to resolve his uncertainty.

In order to understand the captain's reaction, the Board examined other circumstances that might have predisposed his behavior. Because the captain was aware of a mechanical discrepancy with the APU on an earlier flight which resulted in in-flight fumes, it would have been natural for this information to influence his perception of the initial report of smoke. However, the APU was not operating; therefore, the captain should have dismissed it as being the source of any fumes.

Further, with the flight only a few minutes away from landing, the captain was entering into a high activity level, and he had limited options available to deviate from the succession of events and activities already set in motion. That is, his current flight path, speed, and traffic sequence already was directed toward getting the airplane on the ground expeditiously, and he considered an expeditious landing the only immediate option available to alleviate this abnormal and ill-defined situation.

The Safety Board believes that these circumstances may have operated in concert to predispose the captain to disbelieve the reports of smoke, and to establish a mind set that the cabin crew was instead experiencing the less serious fumes.

The captain's skepticism about the report of smoke was also reflected in the first officer's dialogue with the cabin crew. His comments appear to be more of a challenge of the accuracy of the reports than an effort to get additional details. Even after he determined the problem in the cabin to be serious and after he recognized the need for timely firefighting assistance on landing, the first officer failed to aggressively recommend that crash/fire/rescue equipment meet the airplane.

On identifying smoke in the passenger cabin, flight attendant No. 4 recognized the potential seriousness of the problem and without hesitation, even under "sterile cockpit" conditions, immediately informed the first officer about the condition. Subsequent actions by the cabin crew, including efforts to locate the source of the fire, maintaining open communications with the cockpit, using a deadheading crewmember to evaluate and communicate information about the problem, and moving passengers from the affected area, also demonstrated that they considered the problem to be serious.

In conclusion, the Safety Board believes that while it is unlikely that the captain could have taken any action to land the plane more quickly, the cockpit crew failed to use the cabin crew effectively to obtain an accurate understanding of the developing problem. Had communications between the cockpit crew and the cabin crew been more effective, the Safety Board believes that the captain

would have called for fire/rescue equipment to meet the airplane and ordered an emergency evacuation on the runway. The Safety Board believes that American Airlines should use this exarnple in cockpit and cabin crew coordination training to illustrate the need for cockpit crews to more effectively use cabin crews in describing suspected in-flight safety problems and to emphasize the need for cabin crews to be assertive when communicating information about safety problems to cockpit crews.

The Safety Board previously addressed the issue of cockpit and cabin crew coordination training as a result of its investigation of the in-flight fire aboard a DC-9 at Cincinnati, Ohio, on June 2, 1983.[12] As a result of its investigation, the Safety Board issued Safety Recommendation A-84-76 which called for the FAA to require its principal operations inspectors to review air carrier training and if necessary, require amendments concerning actions flight crews should take for immediately and aggressively determining the source and severity of any reported cabin fire. In responses to this recommendation, on November 2, 1984, and March 7,1986, the FAA advised that it believed that current rules and guidance did not warrant further action. As a result, on May 12, 1986, the Safety Board classified Safety Recommendation A-84-76 "Closed--Unacceptable Action."

Subsequent to the Safety Board closing the recommendation, the FAA developed two proposed advisory circulars that addressed cabin safety training for crewmembers and improved coordination and communications among and between cockpit and cabin crews. The Safety Board commented in support of the FAA's proposals. The lack of close coordination and timely exchange of accurate information among crewmembers were clearly problems during preparations for a possible emergency landing of a DC-8 at Portland, Oregon, in 1978; during an in-flight fire aboard an L-1011 at Riyadh, Saudi Arabia, in 1980; during preparations for a possible ditching of an L-1011 near Miami, Florida, in 1985; and during an in-flight fire aboard a DC-9 at Cincinnati, Ohio, in 1985. These instances, as well as this in-flight fire, vividly support improved coordination and communications and joint cockpit and cabin crew training with respect to conducting emergency procedures and periodic emergency drills in which cockpit/cabin crew coordination and communication are practiced.

2.5 Evacuation and Survival Factors

The lethal threat of smoke and fire in aircraft to passenger safety and the need to remove passengers from that environment quickly is well acknowledged. Because the captain failed to order an emergency evacuation of the airplane until 2 minutes 8 seconds after touchdown, the passengers were unnecessarily exposed to these threats for about 1 1/2 minutes longer than necessary.

The captain's delayed decision also increased the time necessary to evacuate the airplane; therefore, flight attendants did not have time to use the public address system to prepare passengers for a quick exit or to provide clear, oral instructions to passengers on evacuation procedures. Consequently, while most passengers considered the evacuation orderly, some complained that they could not hear commands shouted by the flight attendants until they were near the exits. As a result, the evacuation was delayed when passengers were stopped at exits to remove their shoes and to discard their carry-on luggage. The delayed decision to evacuate also prevented crash/fire/rescue personnel from being in place to assist in the evacuation and to protect passengers should the fire have broken through to the cabin.

---

[12]Aircraft Accident Report--*Air Canada Flight 797 McDonnell Douglas DC-9-32, C-FTLU, Greater Cincinnati International Airport, June 2, 1983* (NTSB/AAR-84/09).

The Safety Board concluded that the actions of the flight attendants were performed in accordance with American Airlines training and procedures. The Safety Board noted that American Airlines emergency procedures require flight attendants to instruct passengers to remove shoes, while passenger safety information cards provide no similar instructions. The Safety Board believes that the communication of emergency evacuation procedures to passengers could be improved if American Airlines operational procedures, manuals, training, the flight attendants' oral instructions, and passenger safety information cards provide consistent instructions to passengers regarding the removal of shoes. The Safety Board also urges the FAA to instruct principal operations inspectors to determine if passenger safety cards and flight attendant instructions to passengers for emergency evacuations are consistent with each air carrier's evacuation procedures.

Although some air carriers instruct passengers to remove shoes during unplanned emergency evacuations to prevent damage to slides, other air carriers do not. The Safety Board is aware that slide manufacturers have not recommended that shoes be removed. Certification demonstrations by air carriers and airplane manufacturers of evacuation systems have been routinely conducted with persons wearing tennis-type shoes and other low-heeled shoes Although there have been instances when passengers' shoes, particularly women's high-heeled shoes, have damaged slides or have caught on the slide fabric and injured persons; these instances are infrequent. On the other hand, there have been instances when passengers and crewmembers have removed shoes and successfully evacuated a crashed airplane only to sustain frostbite and injuries when they walked on wreckage and through fire.

The Safety Board is also aware of recent actions by the FAA to require the sliding surface of evacuation slides to be more puncture resistant. It appears that in view of the FAA's recent actions and the need for the crew and passengers to have foot protection following an evacuation, the FAA should research the safety aspects of removing shoes during an evacuation.

After the airplane was evacuated, actions taken by American Airlines ground personnel, although well intended, could have resulted in the destruction of the airplane or the loss of lives. By opening the doors to cargo compartments suspected to contain fires without having the appropriate firefighting equipment available, ground personnel may compromise cargo compartment fire safety systems, supply oxygen to fires, and cause fires to spread or intensify. Ground personnel who are expected to respond to an aircraft when a fire is suspected should be trained on the appropriate actions to be taken. Further, airline personnel should be instructed not to board aircraft to collect the passengers' carry-on luggage until the aircraft has been declared safe by fire personnel.

3. CONCLUSIONS

3.1 Findings

1. The flightcrew and the cabin crew were qualified and trained in accordance with FAA regulations and American Airlines requirements.

2. The airplane was maintained in accordance with applicable Federal regulations and company procedures.

3. The hydrogen peroxide solution and sodium orthosilicate-based mixture were not properly packaged, marked, labeled, or described for air transportation.

4. The hydrogen peroxide solution was a 50 percent concentration solution and was prohibited in any quantity aboard the airplane.

5. The hydrogen peroxide solution leaked from the polyethylene drum before being loaded aboard American 132 and again in flight while aboard American 132.

6. A combination of the hydrogen peroxide solution, sodium orthosilicate-based mixture, and the previously wet fiber drum caused the in-flight fire in the midcargo compartment.

7. The hazardous characteristics of the hydrogen peroxide solution and the sodium orthosilicate-based mixture and hazard warning information on containers of these materials at the shipper's facilities should have been sufficient to have caused the shipper to have determined that they presented hazards and should have taken required precautions for shipping these materials by air, irrespective of knowledge of specific Federal transportation regulations.

8. Notices to warn the public about restrictions governing the transportation of hazardous materials by air are inadequate.

9. Air carrier procedures for identifying undeclared hazardous materials in general freight are inadequate.

10. The cockpit crew had no positive means to identify the presence of an in-flight fire or its location because the cargo compartment had no fire or smoke detection system.

11. The class D midcargo compartment failed to meet the intent of 14 CFR 25.857(d) and resulted in the airworthiness of the airplane being threatened when the fire breached the cargo compartment.

12. The transportation of oxidizers in class D cargo compartments is unsafe because class D cargo compartments are intended to smother fires through oxygen starvation.

13. The aluminum support straps for the cargo compartment liners in the midcargo compartment were not protected sufficiently to provide thermal protection equivalent to the liners.

14. The cockpit crew erroneously concluded that fumes rather than smoke were present in the passenger cabin.

15. An earlier problem with fumes in the passenger cabin contributed to the cockpit crew's failure to evaluate correctly the cause of the in-flight problem.

16. No in-flight emergency was declared.

17. No further action could have been taken by the cockpit crew to land the airplane more quickly after the in-flight problem was detected.

18. Because no in-flight emergency was declared and the airplane was not evacuated immediately after landing, passengers and crewmembers were unnecessarily exposed to the threat of fire for 1 1/2 minutes longer than necessary, and the flight attendants were not able to prepare the passengers before landing for a quick exit.

19. Emergency passenger evacuation procedures on passenger safety cards were not consistent with oral instructions.

20. Air carrier ground personnel increased the risk of spreading the cargo compartment fire by opening cargo compartment doors.

21. Air carrier ground personnel unnecessarily risked personal injury by entering the passenger cabin of the airplane to remove passenger belongings before the fire was extinguished and the airplane determined to be safe.

3.2 Probable Cause

The National Transportation Safety Board determines the probable cause of the in-flight fire to be a chemical reaction resulting from a hydrogen peroxide solution, in concentration prohibited for air transportation, which leaked and combined with the sodium orthosilicate-based mixture from an undeclared and improperly prepared container. The probable cause of the unauthorized transportation was the shipper's lack of knowledge about restrictions and requirements for hazardous materials and inadequate procedures for detecting undeclared hazardous materials shipments. Contributing to the delay in detecting the in-flight fire and the captain's decision not to declare an in-flight emergency was the lack of heat or smoke detection equipment in the cargo compartment and insufficient flightcrew communication. Contributing to the threat to the airworthiness of the airplane was the lack of a fire extinguishment system for the cargo compartment and the inadequate design of the cargo compartment ceiling.

4. RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board made the following recommendations:

--to Textile Treatments International, Inc.:

Establish and implement a hazardous materials transportation safety training program for all persons responsible for packaging, shipping, or transporting hazardous materials. (Class II, Priority Action) (I-88-7)

--to American Airlines:

Revise procedures for accepting general freight packages for transportation to include questions developed to aid in identifying hazardous materials in packages that are not declared by shippers. (Class II, Priority Action) (A-88-115)

Improve the design, content, and posted location of hazardous materials restriction notices to attract the attention of passengers and shippers and to increase the effectiveness of the warning notice. (Class II, Priority Action) (A-88-116)

Review and modify as needed training programs to require joint cockpit and cabin crew training with respect to emergency procedures; specific attention should be given to conducting periodic emergency drills in which cockpit/cabin crew coordination and communication are practiced. (Class II, Priority Action) (A-88-117)

Amend, as appropriate, operational procedures, manuals, training, flight attendants' oral instructions, and passenger safety cards to provide consistent instructions to passengers on emergency evacuation actions. (Class II, Priority Action) (A-88-118)

Train ground personnel who respond to aircraft emergencies on the proper procedures to be taken when aircraft fires are suspected. (Class II, Priority Action) (A-88-119)

--to the Research and Special Programs Administration:

Require hazardous materials restriction notices to be posted at all air transportation freight acceptance facilities including air freight forwarder facilities. (Class II, Priority Action) (A-88-120)

--to the Federal Aviation Administration:

Develop written guidelines for use by persons responsible for inspecting air carrier facilities, require those persons to determine if hazardous materials warning notices are "prominently displayed" in all required locations, and require corrective actions as necessary. (Class II, Priority Action) (A-88-121)

Require fire/smoke detection systems for all class D cargo compartments. (Class II, Priority Action) (A-88-122)

Require a fire extinguishment system for all class D cargo compartments. (Class II, Priority Action) (A-88-123)

Evaluate prohibiting the transportation of oxidizers in cargo compartments that do not have fire/smoke detection and fire extinguishment systems, and determine if other classes of hazardous materials also should be excluded from cargo compartments without these safety systems. (Class II, Priority Action) (A-88-124)

Review the certification of all types of cargo compartments to identify any aluminum or other components that fail to meet thermal protection requirements at least equal to cargo compartment liner thermal protection requirements. Require that all safety deficiencies be corrected. (Class II, Priority Action) (A-88-125)

Require passenger carriers operating under Title 14 Code of Federal Regulations Parts 121 and 135 to include in training programs joint cockpit and cabin crew training on emergency procedures and to conduct periodic emergency drills in which cockpit/cabincrew coordination and communication are practiced. (Class II, Priority Action) (A-88-126)

Consider effects of authorized hazardous materials cargo in fires for all types of cargo compartments, and require appropriate safety systems to protect the aircraft and occupants. (Class II, Priority Action) (A-88-127)

Instruct principal operations inspectors to determine if passenger safety cards and flight attendant instructions to passengers for emergency evacuations are consistent with each air carrier's evacuation procedures. (Class II, Priority Action) (A-88-128)

--to the Air Transport Associationof America:

Develop, in coordination with members, a program to more effectively inform and warn passengers and shippers about restrictions and safety requirements for hazardous materials and to improve methods of detecting undeclared hazardous materials offered for air transportation. (Class II, Priority Action) (A-88-129)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES L. KOLSTAD
Acting Chairman

/s/ JIM BURNETT
Member

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

/s/ LEMOINE V. DICKINSON, JR.
Member

September 13, 1988

5. APPENDIXES

APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of the accident on the evening of February 3, 1988. An investigation team from Washington, D.C., and Atlanta, Georgia, arrived the following day. Investigation groups were established for hazardous materials, cockpit voice recorder, airworthiness, operations, and survival factors.

Deposition Proceedings

The Safety Board convened a proceeding on February 24, 1988, to obtain sworn statements as part of its investigation of this incident. However, on advice of counsel, the shipper's witnesses declined to testify under their Fifth Amendment rights. Parties to the investigation included the Federal Aviation Administration, American Airlines, the Allied Pilots Association, and the Association of Professional Flight Attendants.

APPENDIX B

COCKPIT VOICE RECORDER TRANSCRIPT

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Technology
Washington, D.C.

July 7, 1988

Addendum to Group Chairman Factual Report of Investigation
Cockpit Voice Recorder

DCA-88-HZ-002

A. ACCIDENT

Location: Nashville Metropolitan Airport, Nashville, Tennessee

Date : February 3, 1988

Time : 1615 Central Daylight Savings Time (CDT)

Aircraft: McDonnel Douglas MD-80 N569AA American Airlines, Inc.

B. GROUP

Not Applicable

C. SUMMARY

A recording removed from a Fairchild Model A-100A Cockpit Voice Recorder (CVR) SN 52020 was examined to document when the "fasten seat belts" chime was heard on the CVR recording.

D. DETAILS OF INVESTIGATION

A cabin chime that was identified as the "fasten seatbelts" announcement was heard on the CVR at 1603:16 CST, approximately 5 minutes prior to the start of the CVR group transcript.

Preceding page blank

James R. Cash
Electronic Engineer

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Technology
Washington, D. C.

GROUP CHAIRMAN'S FACTUAL REPORT OF INVESTIGATION
COCKPIT VOICE RECORDER

BY

JAMES R. CASH
ELECTRONIC ENGINEER

WARNING

The reader of this report is cautioned that the transcription of a CVR tape is not a precise science but is the best product possible from an NTSB group investigative effort. The transcript, or parts thereof, if taken out of context, could be misleading. The attached CVR transcript should be viewed as an accident investigation tool to be used in conjunction with other evidence gathered during the investigation. Conclusions or interpretations should not be made using the transcript as the sole source of information.

APPENDIX B

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Technology
Washington, D.C. 20594

March 28, 1988

Group Chairman Factual Report of Investigation
Cockpit Voice Recorder
DCA 88 HZ 002

A. ACCIDENT

Location : Nashville Metropolitan Airport, Nashville, Tennessee
Date : February 3, 1988
Time : 1615 Central Standard Time (CST)
Aircraft : McDonnell Douglas MD-80 N569AA American Airlines Inc.

B. GROUP

James R. Cash National Transportation Safety Board Chairman
Frank H. Hughes Federal Aviation Administration Member
Dennis M Kilroy Allied Pilots Association Member
D.F. Hattler Allied Pilots Association Member
Jerry S. Fowler American Airlines Inc. Member
John A. Feil American Airlines Inc. Member

C. SUMMARY

A Fairchild model A-100A cockpit voice recorder (CVR) SN 52020 was sent to the audio laboratory of the National Transportation Safety Board. A transcript was prepared of the final 8 minutes of the excellent quality 30 minute recording.

D. DETAILS OF THE INVESTIGATION

The CVR recording starts at 1545:34 central standard time (CST) while the aircraft is starting its descent into the Nashville Airport. The transcript starts at 1608:28 CST just prior to the first notification of the flight crew that there was smoke in the cabin. The verbatum transcript continues through the approach and landing at Nashville. Electrical power is removed from the CVR at 1617:14 CST just after the emergency evacuation notification was given.

James R. Cash

James R. Cash
Electronics Engineer

TRANSCRIPT OF A FAIRCHILD MODEL A-100A COCKPIT VOICE RECORDER S/N 52020 WHICH WAS REMOVED FROM AN AMERICAN AIRLINES MCDONNELL DOUGLAS MD-80 N569AA WHICH WAS INVOLVED IN AN ACCIDENT AT THE NASHVILLE METROPOLITAN AIRPORT, NASHVILLE TENNESSEE, ON FEBRUARY 3, 1988.

CAM	Cockpit area microphone voice or sound source
RDO	Radio transmission from accident aircraft
INT	Intercom voice or sound source
-1	Voice identified as Captain
-2	Voice identified as First Officer
-3	Voice identified as Female Flight Attendant
-4	Voice identified as Dead-heading American First Officer
-5	Voice identified as Female Flight Attendant
-?	Voice unidentified
APP	Nashville Radar Approach Control
TWR	Nashville Local Control (Tower)
GND	Nashville Ground Control
CAWS	Central Aural Warning System
UNK	Unknown
*	Unintelligible word
@	Nonpertinent word
#	Expletive deleted
%	Break in continuity
( )	Questionable text
(( ))	Editorial insertion
-	Pause
NOTE:	All times are expressed in Central Standard Time (CST).

INTRA-COCKPIT TIME& SOURCE	CONTENT
1608:28	((start of transcript))

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1608:28 RDO-2	Nashville approach American one thirty two level six thousand
1608:31 APP	American one thirty two Nashville approach roger descend and maintain four thousand
1608:35 RDO-2	four thousand American one three two leavin' six
1608:39 APP	and American one thirty two fly heading one zero zero vectors for the ILS
1608:45 RDO-2	one zero zero vectors where American one thirty two
1608:48 APP	vectors for the ILS two left
1608:50 RDO-2	roger American one thirty two

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1609:05 INT-2	hello		
1609:06 INT-3	hi we've got smoke in the cabin		
1609:07 INT-2	okay		
1609:08 INT-3	there's we don't know where it's comin' from it's past the ah exit -- get a h_2o extinguisher--		
		1609:09 APP	American one thirty two descend and maintain two thousand five hundred
		1609:11 ROO-1	two thousand five hundred American one thirty two
1609:14 CAM-2	we got smoke in the ah --		
1609:15 INT-3	it's a real bad smell		
1609:16 INT-2	okay I smell it up here now		

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1609:17 INT-3	okay		
1609:20 INT-2	okay		
1609:21 INT-3	okay		
1609:23 INT-2	stay on		
1609:29 CAM-2	smell the smoke - got smoke in the cabin		
1609:30 CAM-1	smoke - or		
1609:34 CAM-2	naw it smells electrical		
CAM-1	fumes		
1609:37 CAM-2	they can't tell where it's comin' from		
1609:38 INT-2	still on here		

INTRA-COCKPIT

TIME& SOURCE	CONTENT
1609:43 CAM-2	it smells electrical
1609:54 CAM-1	is it fumes or smoke
1609:57 CAM	((sound of cabin call chimes))
1610:05 INT-2	still there
1610:06 INT-3	yeah ah pilot said the floor is getting really soft and he said we need to land
1610:11 INT-2	okay who says the floor is getting soft

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
1609:45 APP	American one thirty two primary target just popped up one oclock twelve to one oclock and a mile and a half turning northbound type and altitude unknown
1610:01 RDO-1	one thirty two
1610:04 APP	one thirty two he just disappeared off my scope

INTRA-COCKPIT TIME& SOURCE	CONTENT
INT-3	here he is
1610:15 INT-4	hey boss
1610:16 INT-2	yes
1610:17 INT-4	this is @ @ ((name))first officer seven twenty seven you got the floor back here in the middle is dropping out slightly
1610:24 INT-2	okay
1610:24 CAM	((sound of trim in motion horn))
1610:25 INT-4	you gunna have to land this thing in a hurry

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1610:12 APP	American one thirty two is ah six from the marker turn left heading zero four zero maintain two thousand five hundred until established on the localizer cleared ILS two left approach
1610:21 RDO-1	cleared two left zero four zero American one thirty two

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1610:26 INT-2	okay we're gettin' it down now		
1610:27 INT-4	okay be quick		
INT-2	okay		
1610:28 INT-4	hey have the trucks meet us		
1610:29 CAM	((sound of trim in motion horn))		
1610:30 CAM-2	have a flight officer back there says that the floor is getting soft -- probably ought to drop the gear - there's somethin' going on in the ah floor board		
1610:37 INT-2	anybody back on		
1610:39 CAM-1	put the gear down		
1610:40 CAM	((sound of landing gear being lowered))		
1610:40 CAM	((sound of cabin chime))		

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1610:47 INT-3	@ ((name))		
1610:48 INT-2	okay stay with me now okay		
1610:50 INT-3	okay		
1610:53 INT-2	okay now how far back is the floor getting soft		
1610:57 CAM	((sound of cabin chime))		
1611:09 INT-5	pick up the phone		
1611:11 INT-3	hello		
1611:12 INT-2	okay you still on		
INT-3	yes		
INT-5	yeah		

INTRA-COCKPIT TIME& SOURCE	CONTENT
1611:13 INT-2	how far back is the floor getting soft
1611:15 INT-3	well ah the captain is in the aisle right now he's about midway through to -
1611:23 INT-2	about where the gear might be
1611:24 INT-3	yes
1611:25 INT-2	okay
1611:26 CAM	((sound of trim in motion horn))
1611:29 INT-2	okay why don't you go back and ah buckle in
1611:31 INT-3	we're all seated
1611:32 INT-5	we are

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1611:33 APP	American one thirty two contact the tower one one niner point one see ya

INTRA-COCKPIT TIME& SOURCE	CONTENT
INT-2	okay fine
1611:38 CAM	((sound of trim in motion horn))
1611:40 CAM-2	okay my ah what do you want me to do here
1611:42 CAM-1	this is tower
1611:47 CAM-2	okay
INT-2	you still there
1611:53 CAM-2	okay seatbelt -
1611:54 CAM-1	yes
1611:55 CAM-2	no smoking sign -*

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1611:36 RDO-1	ninteen one good day

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1611:57 CAM-1	no smoke just fumes right		
1611:59 CAM-2	so far it's just smoke --- fumes		
1612:05 CAM	((sound of cabin chime))		
1612:06 INT-3	@ ((name))		
1612:08 INT-2	okay you don't see any smoke it's just fumes		
1612:09 INT-5	this is @ ((name))		
1612:10 INT-3	bad fumes		
1612:11 INT-2	just bad fumes-		
INT-5	yes		
1612:12 INT-3	startin' to hurt my eyes now		
INT-2	okay		

INTRA-COCKPIT TIME& SOURCE	CONTENT
1612:16 INT-2	okay I'm gunna get off the phone and ah call me if anything important changes
1612:19 INT-3	okay
1612:22 CAM-1	did you call tower
CAM-2	*
1612:35 CAM-1	no problems
1612:37 CAM-2	there's just fumes back there
1612:42 CAM	((sound of unintelligable female flight attendent briefing))

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1612:25 RDO-2	tower American one thirty two is five point eight DME out now
1612:30 TWR	American one thirty two Nashville tower wind calm runway two left cleared to land
1612:33 RDO-2	cleared to land American one thirty two

INTRA-COCKPIT		AIR-GROUND COMMUNICATIONS	
TIME& SOURCE	CONTENT	TIME & SOURCE	CONTENT
1612:44 CAM-1	we've had fumes before ah - from the APU is where it was at least initially		
1612:47 CAM-1	okay we got gear-		
1612:49 CAM-2	gear		
1612:50 CAM-1	-spoiler lever auto brakes no - flaps are good - lights - are we cleared to land		
1612:56 CAM	((sound of trim in motion horn))		
		1612:57 RDO-2	American one thirty two are we cleared to land
		1612:59 TWR	affirmative
		1613:00 RDO-2	roger
1613:01 CAM-2	do you want to have any ah -		
1613:02 CAM-1	thousand		

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1613:05 CAM	((sound of trim in motion horn))		
1613:06 CAM-2	thousand ah flaps [illegible]e -		
CAM-1	forty		
CAM-2	forty forty land		
1613:09 CAM	((sound of trim in motion horn))		
1613:11 CAM-2	do you want to call any ah		
1613:12 CAM-1	we don't have a problem yet just a few fumes		
1613:16 CAM-2	you don't smell it		
1613:17 CAM-1	yeah I smell it		
1613:21 CAM-1	autopilot's off auto throttles *		
1613:25 CAM-2	you're cleared to land - landing checklist is complete		

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1613:40 CAM-2	five hundred feet sinkin' a thousand plus five		
1613:44 CAM-2	four hundred		
1613:49 CAM	((sound of trim in motion horn))		
1613:55 CAM-2	three hundred		
1614:03 CAM-2	there's two hundred sink nine		
1614:11 CAM-2	one hundred		
1614:13 CAM-2	on the tape fifty-		
1514:14 CAM-2	forty - thirty -		
1614:16 CAM-2	twenty-		
1614:17 CAM-2	ten		
1614:20 CAM-2	five		

INTRA-COCKPIT TIME& SOURCE	CONTENT
1614:22 CAM	((sound of touchdown))
1614:23 CAM	((sound similar to spoiler auto deployment))
CAM	*
1614:28 CAM-2	amber
1614:30 CAM-2	reverse
1614:31 CAM	((sound of increasing engine noise))
1614:35 CAM-2	hundred knots
1614:40 CAM-2	eighty knots

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1614:41 TWR	American one thirty two turn right when able contact ground control
1614:44 RDO-2	American one thirty two

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1614:45 CAM-2	sixty knots		
1615:01 CAWS	((stabilizer))		
		1615:09 RDO-2	ground American one thirty two goin' to charlie sixteen
		1615:14 GND	American one thirty two Nashville ground roger your option to enter tango two or come down to tango four advise
		1615:20 CAM-2	tango two or tango four
1615:21 CAM-1	ah lets see		
CAM	((sound of unintelligable female flight attendent briefing))		
		1615:24 RDO-2	this is my first time in here so let me look this up

INTRA-COCKPIT TIME& SOURCE	CONTENT
1615:34 CAM-1	we don't have a sixteen -- where the # is sixteen
1615:46 CAM-1	* oh there it is all the way around
1615:52 CAM	((sound of cabin chimes))
1615:55 INT-2	I'm here

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1615:26 GND	well tango two is just ahead there ah if you make the and keep goin' turn southbound and you can turn it there and taxi along the ramp futher or the taxi ways on the outer your choice
1615:39 GND	I believe I would suggest "T"-four probably be a little quicker for ya
1615:43 RDO-2	"T"-four okay
1615:45 GND	*

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1615:56 INT-4	yeah this is @ ((name)) you've got a big problem back here and I'm not sure if you - the problem is I don't where the heat is comin' from it's comin' up through the floor --		
1616:02 INT-2	do you see any smoke		
1616:05 INT-4	yeah there's smoke just a little bit		
1616:06 INT-2	okay okay		
1616:07 INT-4	we better get outta here		
1616:08 INT-2	alright		
1616:09 INT-3	ah captain -		
1616:10 CAM-2	there's a crew back there that says we better get outta here he says there's smoke comin' through the floor		
1616:11 INT-2	are you there		

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1616:13 INT-3	yeah I'm here number four		
1616:14 INT-2	there's smoke coming through the floor now		
1616:16 INT-3	ah I don't see it ah we had a first officer here with us he's the one he's been checkin' the floor he's in uniform that's ah who you've been talkin' to		
CAM-2	she don't see it		
1616:25 INT-2	okay		
1616:26 INT-3	he think- it's real soft the floor is real soft		
1616:27 CAWS	(stabilizer))		
1616:28 CAM-2	the floor is very very soft		
1616:30 CAM-1	okay let's get out of here call ground		
1616:32 INT-2	okay we're gunna get out of the airplane now		

INTRA-COCKPIT TIME& SOURCE	CONTENT
1616:34 INT-3	okay easy ah with an easy victor
1616:35 INT-2	ah stand by
1616:37 INT-3	okay
1616:41 CAM-1	give me the checklist
1616:54 CAM-2	okay ground evac ah tower called the tower flaps

AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1616:34 GND	American one thirty two thats ah tango two thats fine just around contact ramp control one three one eight seven ah they'll direct ya
1616:43 RDO-2	ah roger sir would you call out the fire equipment we've got the possibility of some fire some real hot stuff in the cargo compartment the floor is real hot we're gunna get em out
1616:53 GND	okay we got em on the phone American one thirty two

INTRA-COCKPIT TIME& SOURCE	CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	CONTENT
1616:58 CAM-1	forty		
1617:02 CAM-2	spoiler lever		
1617:03 CAM-1	you get out of here you go help		
1617:04 CAM-1	retract brakes are park fuel levers --		
1617:13 CAM-1	cutoff-		
1617:14	((end of recording))		

APPENDIX B

APPENDIX C

PASSENGER SAFETY CARD

FOR YOUR SAFETY

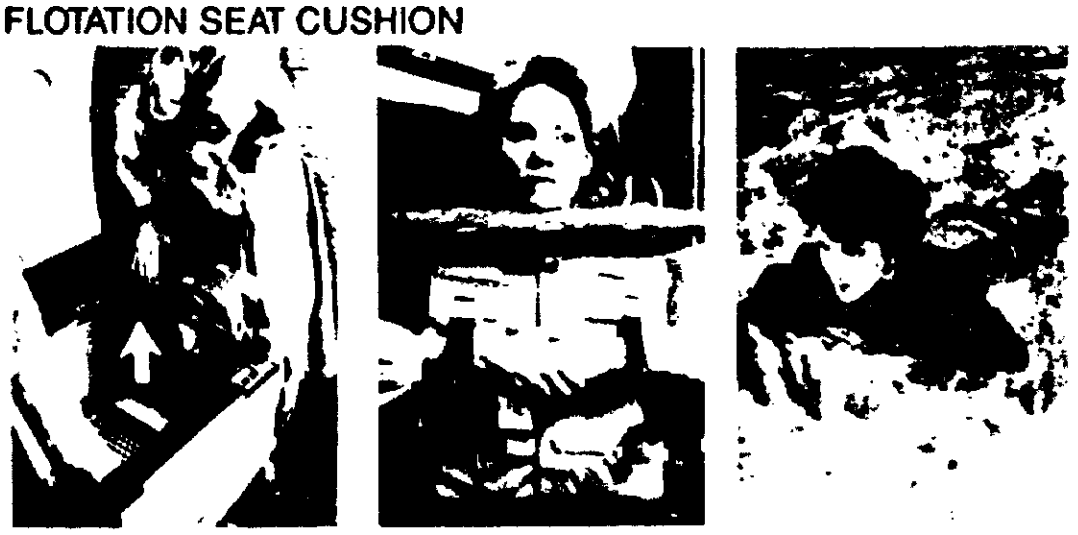
SUPER 80
AmericanAirlines

SEAT BELT

OXYGEN

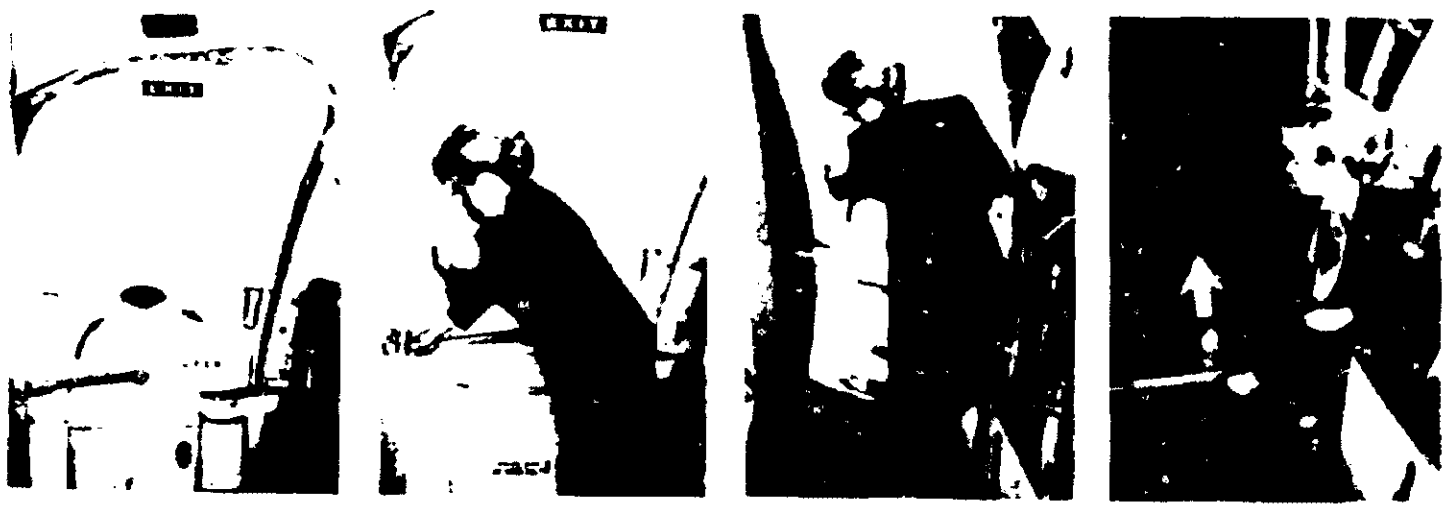
BRACE POSITIONS

FLOTATION SEAT CUSHION



PLEASE DO NOT REMOVE THIS CARD FROM AIRPLANE

DOOR EXITS



WINDOW EXITS

TAILCONE EXIT

EMERGENCY EXIT ROUTES

STAY ON YOUR FEET AND JUMP

AISLE LIGHTS

PRINTED IN USA

APPENDIX D

HANDWRITTEN AIR WAYBILL

001 09979023 001 09979023

SHIPPER'S NAME AND ADDRESS: Bob Busbey
Textile Treatments Intl
1316 W. 5th Austin, TX 78703

SHIPPER'S ACCOUNT NUMBER:

CONSIGNEE'S NAME AND ADDRESS: Bob Busbey
Hold at AA Air Frt For Pick up

CONSIGNEE'S ACCOUNT NUMBER:

Air Waybill
American Airlines, Inc.
P O BOX 61616 D/FW AIRPORT TEXAS 75261 U S A
Copies 1, 2 and 3 of this Air Waybill are originals and have the same validity

(IT IS AGREED THAT THE GOODS DESCRIBED HEREIN ARE ACCEPTED IN APPARENT GOOD ORDER AND CONDITION (EXCEPT AS NOTED) FOR CARRIAGE SUBJECT TO THE CONDITIONS OF CONTRACT ON THE REVERSE HEREOF THE SHIPPER'S ATTENTION IS DRAWN TO THE NOTICE CONCERNING CARRIER'S LIMITATION OF LIABILITY SHIPPER MAY INCREASE SUCH LIMITATION OF LIABILITY BY DECLARING A HIGHER VALUE FOR CARRIAGE AND PAYING A SUPPLEMENTAL CHARGE IF REQUIRED FOR INTERNATIONAL SHIPMENTS THE WARSAW CONVENTION WHICH IN MOST CASES LIMITS THE LIABILITY OF CARRIER MAY APPLY SEE REVERSE SIDE

ISSUING CARRIER'S AGENT NAME AND CITY:

ALSO NOTIFY NAME AND ADDRESS (OPTIONAL ACCOUNTING INFORMATION):

CORPORATE IDENTIFICATION NO:

AGENT'S IATA CODE:

ACCOUNT NO:

GBL GTN NO:

AIRPORT OF DEPARTURE (ADDR OF FIRST CARRIER) AND REQUESTED ROUTING: Austin

SHIPPER REFERENCE NO:

CONSIGNEE REFERENCE NO:

ROUTING AND DESTINATION

TO	BY FIRST CARRIER	TO	BY	TO	BY

CURRENCY	CHGS	WT/VAL	OTHER	DECLARED VALUE FOR CARRIAGE	DECLARED VALUE FOR CUSTOMS
		PP / COLL	PP / COLL		

AIRPORT OF DESTINATION: Nashville

FOR CARRIER USE ONLY: FLIGHT/DATE / FLIGHT/DATE

AMOUNT OF INSURANCE:

INSURANCE — If shipper requests insurance in accordance with conditions on reverse hereof, indicate amount to be insured in figures in box marked amount of insurance.

HANDLING INFORMATION: BNA

NO OF PIECES RCP	GROSS WEIGHT	kg/lb	RATE CLASS	CHARGEABLE WEIGHT	RATE / CHARGE	TOTAL	NATURE AND QUANTITY OF GOODS (INCL DIMENSIONS OR VOLUME)
1	104						Laundry Bag

American Airlines Freight
PAID
Amount $ 64.53
Date 2-2-87 Station AUS
Agent
Check # ☐ Cash ☐ CC BA #

4627009 70006
5461

PREPAID	WEIGHT CHARGE	COLLECT
	64.53	

VALUATION CHARGE

TAX

TOTAL OTHER CHARGES DUE AGENT

TOTAL OTHER CHARGES DUE CARRIER

COD

TOTAL PREPAID / TOTAL COLLECT

DELIVERY CHARGES / DEST ADVANCE CHARGES / DESCRIPTION OF DEST ADVANCE / ITEMS COLLECT

SHIPPER'S REF

OTHER CHARGES AND DESCRIPTION

DESCRIPTION OF ORIGIN ADVANCE / ITEMS PREPAID

Shipper certifies that the particulars on the face hereof are correct and that insofar as any part of the consignment contains hazardous materials or dangerous goods such part is properly described by name and is in proper condition for carriage by air according to the applicable national governmental regulations and for international shipments the current International Air Transport Association Dangerous Goods Regulations

SIGNATURE OF SHIPPER OR HIS AGENT

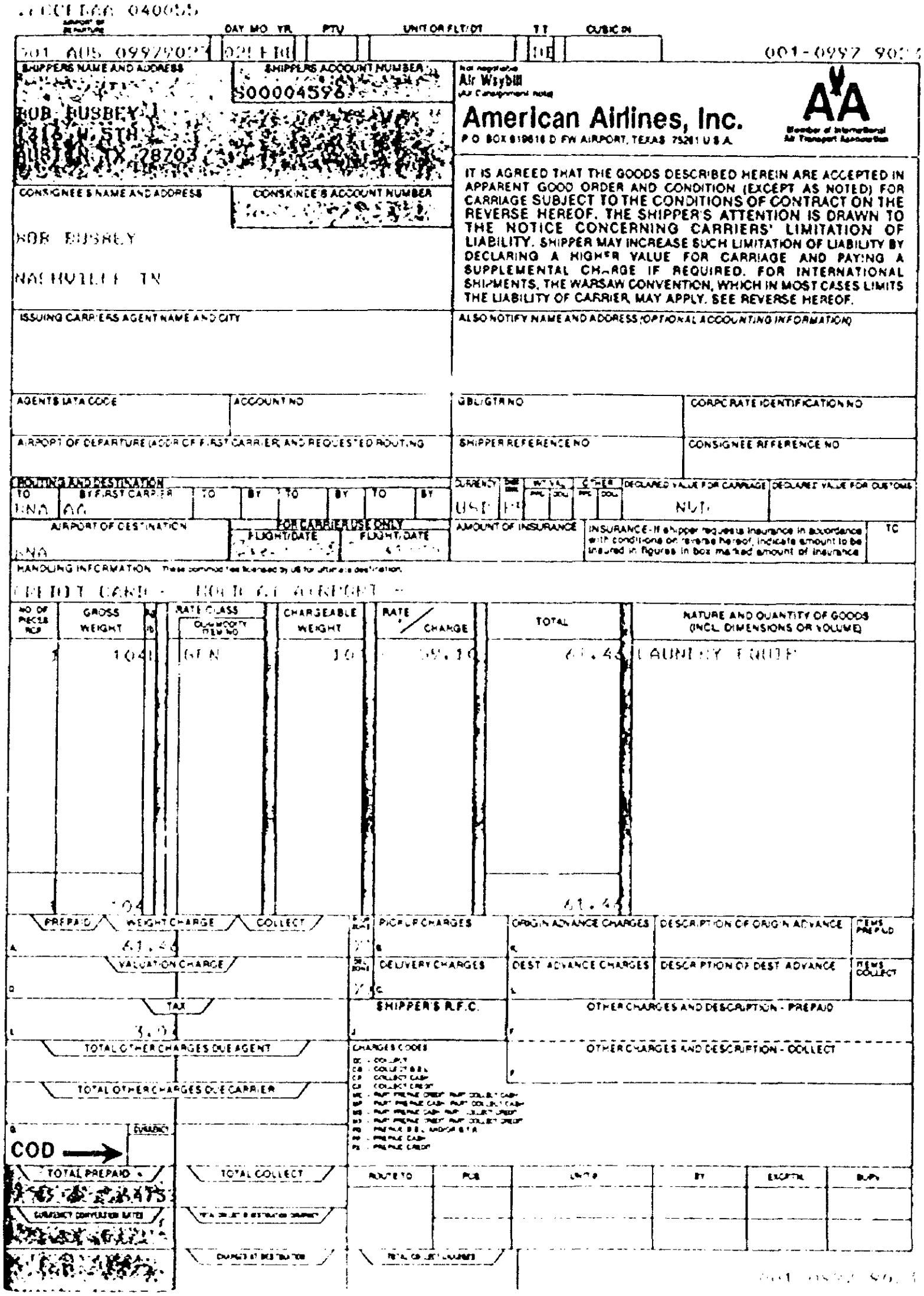
EXECUTED ON 2-2-87 (Date) 1410 (Time) AUS (Place)

SIGNATURE OF ISSUING CARRIER OR ITS AGENT

ORIGINAL 3 (FOR SHIPPER)

APPENDIX E

COMPUTER AIR WAYBILL



COPY 7 (FOR SECOND CARRIER)

Preceding page blank

APPENDIX F

HAZARDOUS MATERIALS CHECKLIST

DANGEROUS GOODS CHECKLIST

AmericanAirlines Freight System

DANGEROUS GOODS CHECKLIST

PREPARE TWO COPIES OF CHECKLIST FOR ALL DANGEROUS GOODS SHIPMENTS EXECEPT THOSE THAT ARE EXEMPT FROM SHIPPERS DECLARATION REQUIREMENT

Airwaybill No. _____ _____ Pcs. _____ Wt. _____ Date _____

Shippers Declaration

	YES	NO
1. Are there at least two candy stripe copies?	☐	☐
2 Complete name and address of shipper/consignee?	☐	☐
3 AirWaybill/Airbill number of transporting carrier?	☐	☐
4 Number of pages shown?	☐	☐
5 Non applicable aircraft box deleted?	☐	☐
6 Name of airports spelled out (for IATA)?	☐	☐
7. Non applicable RAM/NON RAM box deleted? (radioactive material must be on separate declaration)	☐	☐
8 Name title/date/place of signatory complete?	☐	☐
9 Is the declaration FREE of alterations?	☐	☐

Nature and Quantity of Dangerous Goods RADIOACTIVE MATERIAL

	YES	NO	N/A
1 Proper Shipping Name?	☐	☐	
2 Class number (class spelled out for 6-D)?	☐	☐	
3. UN prefix and number?	☐	☐	☐
4 Subsidiary Risk "Secondary Hazard" for 6-D)?	☐	☐	☐
5 The words "Radioactive Material" if not part of proper shipping name?	☐	☐	☐
6 Name Symbol of radionuclide(s)?	☐	☐	
7 Description of phy./chem. form e.g. "Special Form"?	☐	☐	
8 "Low Level Solid", "Low Specific Activity" "Fissile"?	☐	☐	☐
9 Number and type of packages?	☐	☐	
10 Activity in Becquerel or Curie in each pkg.?	☐	☐	
11 "Overpack Used" if applicable?	☐	☐	☐
12 Category of pkgs (White I, Yellow II, Yellow III)?	☐	☐	
13 T.I.'s and dimensions (Yellow II & III only)?	☐	☐	☐
14 "Fissile Exempt" Fissile Class I, II, III if relevant?	☐	☐	☐
15 Number of pkgs. allowed per aircraft (Fissile only)	☐	☐	☐
16 AUTHORIZATIONS Name and Type			
(a) Special Form Approval Certificate	☐	☐	☐
(b) Type B Design Approval Certificate	☐	☐	☐
(c) Type B (M) Design Approval Certificate	☐	☐	☐
(d) Fissile Mat. Pkg. Design Certificate	☐	☐	☐
(e) Fissile mat. Pkg. Shipmt. Certificate	☐	☐	☐
(f) Special Arrangement Approval Certificate	☐	☐	☐
(g) Any similar documents	☐	☐	☐

Nature and Quantity of Dangerous Goods NON-RADIOACTIVE MATERIAL

	YES	NO	N/A
1. Proper Shipping Name (Generic name, if N.O.S.) (EQ)?	☐	☐	
2 Class/Division No. (or Hazard class for 6-D)?	☐	☐	☐
3 UN or ID prefix and number?	☐	☐	
4 Subsidiary Risk No. (Secondary hazard for 6-D)?	☐	☐	☐
5 Number and type of packages "X" net wt. of each?	☐	☐	
6 "Overpack Used" if applicable?	☐	☐	☐
7. Packaging instr.: "Transitional Packaging" used?	☐	☐	☐
8 Packing Group if applicable?	☐	☐	☐
9. (For Class 3 Pkg. Group III) Indication that flash point is 93°F/32°C or below?	☐	☐	☐
10 Listed in sequential order?	☐	☐	☐

Airwaybill/Airbill

	YES	NO	N/A
1 "Dangerous Goods as per attached Shippers Declaration" (except dry ice)?	☐	☐	
2 "Cargo Aircraft Only" if applicable?	☐	☐	☐
3 Dangerous Goods' statement is shown first and separately?	☐	☐	☐
4 For "excepted" radioactive materials			
"Excepted radioactive materials limited quantities"?	☐	☐	
"Excepted radioactive materials instruments/articles"?	☐	☐	☐
"Excepted radioactive materials empty pkgs	☐	☐	
"Excepted radioactive articles manufactured from natural or depleted uranium or natural thorium?	☐	☐	
5 Dangerous Goods Dry Ice 9, UN1845/NSR PKGS Net Wt./Qty. III "Shippers Declaration Not Required"			

Packaging

	YES	NO	N/A
1 Correct labels on each package			
(a) Primary Risk (with UN number)?	☐	☐	
(b) Subsidiary Risk (without number)?	☐	☐	
(c) "Danger Cargo Aircraft Only"?	☐	☐	
2 "THIS WAY UP" label with arrows on opposite sides (THIS END UP" or THIS SIDE UP" for 6-D)?	☐	☐	
3 Name and address of Shipper/Consignee?	☐	☐	
4 Proper Shipping Name?	☐	☐	
5 "Inner packages comply with prescribed specification" (for overpacks only)?	☐	☐	
6 Name of explosive net & gross wt. marks 1.65?	☐	☐	
7 Pkg. in good condition, no leaks, damage?	☐	☐	

Accepted YES ☐ NO ☐

IF ANY ANSWER IS "NO", REFUSE SHIPMENT

Prepared by _____ Checked by _____

This checklist does not purport to be comprehensive and final evaluation of the manner in which your shipment does or does not comply with all applicable government regulations but it is intended only to assist you in identifying certain aspects in which the shipment apparently fails to conform to such regulations

DISTRIBUTION 1. Attach to Source Document
2 Attach to Shipment

AA FORM 7501 PRINTED IN U.S.A.

* U. S. GOVERNMENT PRINTING OFFICE: 1999-242-320:81029

END

DATE
FILMED
1-25-89
NTIS