



# National Transportation Safety Board

Washington, D.C. 20594

## Hazardous Materials Incident Brief

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Accident No.:	DCA-99-MZ-001
Transportation Mode:	Air
Type of Incident:	Spill of undeclared shipment of hazardous materials in cargo compartment of aircraft
Location:	Memphis, Tennessee
Date:	October 28, 1998
Carrier and Flight No.:	Northwest Airlines Flight 957
Aircraft:	Airbus A320
Shipper:	Passenger
Container:	Two plastic gallon bottles in ice chest
Injured:	None
Material Released:	Hydrogen peroxide, 35-percent solution with water, an oxidizer (corrosive)
Type of Failure:	Sides of bottles split

### Description of Incident

On the morning of October 28, 1998, 2 gallons of a 35-percent hydrogen peroxide solution in water, an oxidizer<sup>1</sup> with corrosive properties, spilled in a cargo compartment of Northwest Airlines (Northwest) flight 957, a passenger-carrying airplane en route from Orlando, Florida, to Memphis, Tennessee. The solution leaked from two undeclared 1-gallon plastic bottles that had split. The bottles were in an ice chest that belonged to a passenger on the flight. The leaking hydrogen peroxide contaminated three mail sacks and an undetermined number of bags.

The leak was not discovered until cargo handlers in Memphis began to unload the baggage on flight 957. Thinking that the spilled liquid was water, the cargo handlers ignored it and transferred some of the baggage to other Northwest passenger-carrying flights, including flight 7, which then departed for Seattle, Washington. When flight 7 arrived in Seattle, two bags in a cargo compartment were smoldering, including one that had come from flight 957.

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<sup>1</sup> The Department of Transportation defines an oxidizer as "a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials."

As a result of the spill, several people required treatment. In Memphis, 11 employees were treated at the airport's first aid station because their hands had been exposed to the hydrogen peroxide, and 2 more employees went to a local clinic, where they were treated and released. In Seattle, the employee who removed the smoldering bags from the cargo compartment was exposed to fumes. He went to a hospital for treatment and was released. None of the injuries were serious. Northwest estimated that the total cost of the damage to and the downtime on the aircraft and of the damage to the baggage was more than \$40,000.

## Response to Contaminated Baggage

After flight 957 arrived in Memphis, two Northwest ramp employees entered the cargo compartments, between 0730 and 0745 central standard time, and began transferring the baggage to other aircraft in the morning bank of flights.<sup>2</sup> Both employees noted wet baggage and a clear liquid on the floor. They assumed the liquid was water that had leaked from the ice chest or from a shipment of tropical fish.<sup>3</sup>

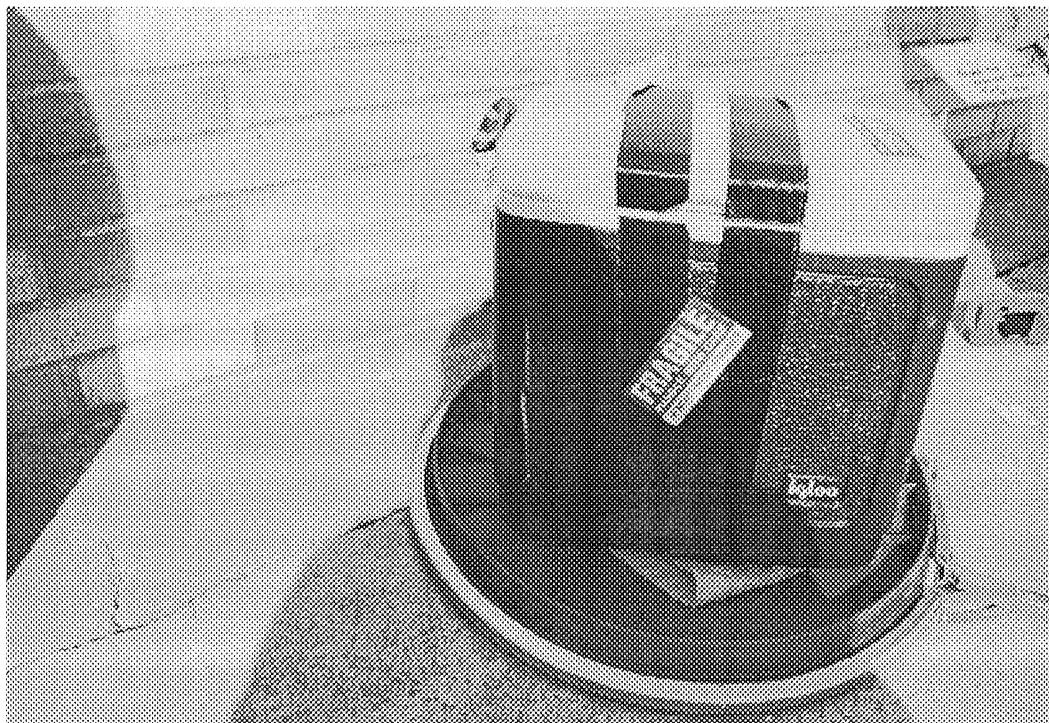
About 10 minutes after the baggage was unloaded, the employees who had handled the wet baggage and mail sacks began to complain that their hands were tingling and turning white. By then, some of the baggage had been transferred to other airplanes, and some had been returned to passengers. The ice chest and several bags had been loaded onto flight 7. (See figure 1.)

Because employees were complaining about their hands, Northwest contacted the airport's fire station, and it responded to the site. Northwest also contacted the airport's post office, which sent a postal employee to pick up the wet mail sacks. A ramp employee retrieved the ice chest from flight 7. When he was told that the ice chest probably contained a hazardous material, he left to seek medical attention. After he left, the pilot of flight 7 noticed that there was a cluster of emergency responders and Northwest employees near the plane. The pilot asked them about the nature of the emergency. They told him that the ice chest might contain a hazardous material. The pilot asked whether the ice chest had been on flight 7. Not knowing that the chest had been on flight 7, several Northwest employees told the pilot that it had not. Thinking that his plane was not affected by the incident, the pilot of flight 7 departed as scheduled.

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<sup>2</sup> Memphis is one of Northwest's hub airports. Northwest has 3 daily banks of about 40 flights; the planes are at the airport for only 1 to 2 hours.

<sup>3</sup> According to the ramp employees, it is common to discover ice chests leaking due to melting ice. Also, live fish are shipped in plastic bags inside fiberboard boxes, and the bags occasionally break, spilling the water from the box.



**Figure 1.** The ice chest that contained the bottles of hydrogen peroxide.

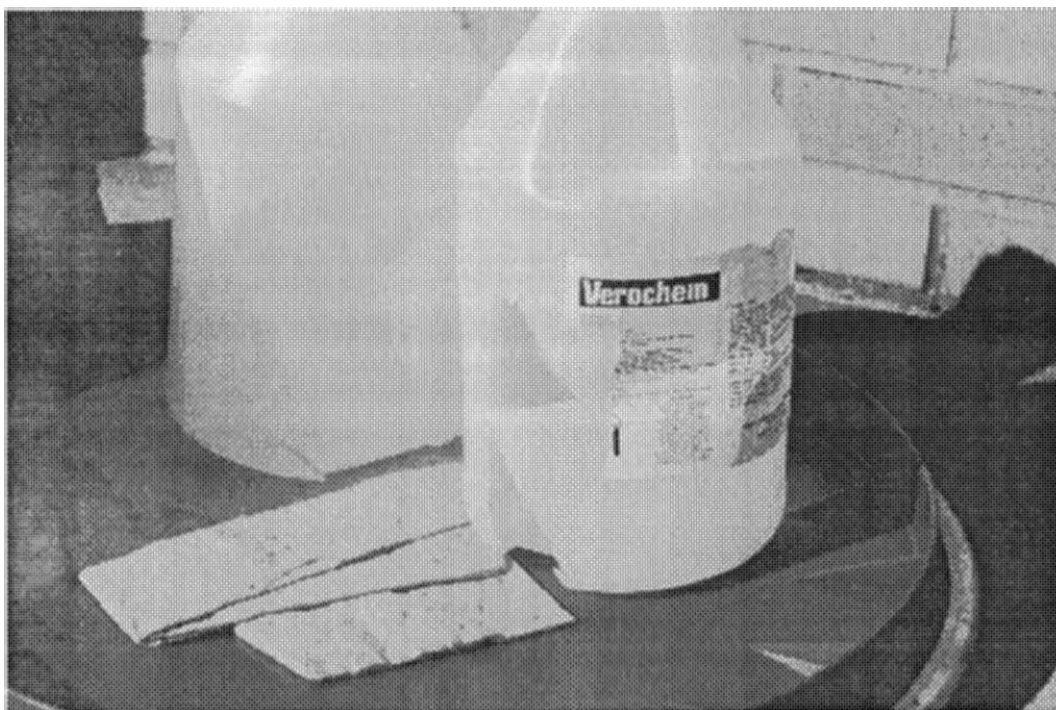
The emergency responders did an on-site examination and found that each bottle had split open and that the hydrogen peroxide had leaked from the bottles and the ice chest. (See figure 2.) Each bottle had a label that said “Vero Chemical Distributors, Inc.,” and had generic warnings about flammable materials. The words “Hydrogen Peroxide” were handwritten in an upper corner of each label. When the responders questioned the passenger who had checked the ice chest, she told them that the bottles had contained a 35-percent solution of hydrogen peroxide.

During the emergency, the fire station responders used the *North American Emergency Response Guide* and a material safety data sheet<sup>4</sup> about hydrogen peroxide as references. Northwest stated that it also contacted the Minnesota Poison Control Center.<sup>5</sup> (There is no record of the information provided by the center; however, a previous employee indicated that, given the nature of the center, its information would have focused on the medical hazards, including the fact that hydrogen peroxide can damage skin.) While the information gathered described some of the hazards posed by hydrogen peroxide, much

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<sup>4</sup> A material safety data sheet is developed by the producer of a chemical product and contains general information about it, including a description of its chemical and physical properties, a description of the health and environmental hazards it poses, and guidelines for responding to its release.

<sup>5</sup> At the time of the incident, the Minnesota Poison Control Center was under contract to Northwest to provide hazardous materials information.



**Figure 2.** Damage to the bottles of hydrogen peroxide.

of it did not point out that hydrogen peroxide that has dried on certain materials is a fire hazard. A fire station responder stated that the responders were concerned about the danger of fire from materials exposed to the oxidizing properties of hydrogen peroxide and had warned the Northwest employees.

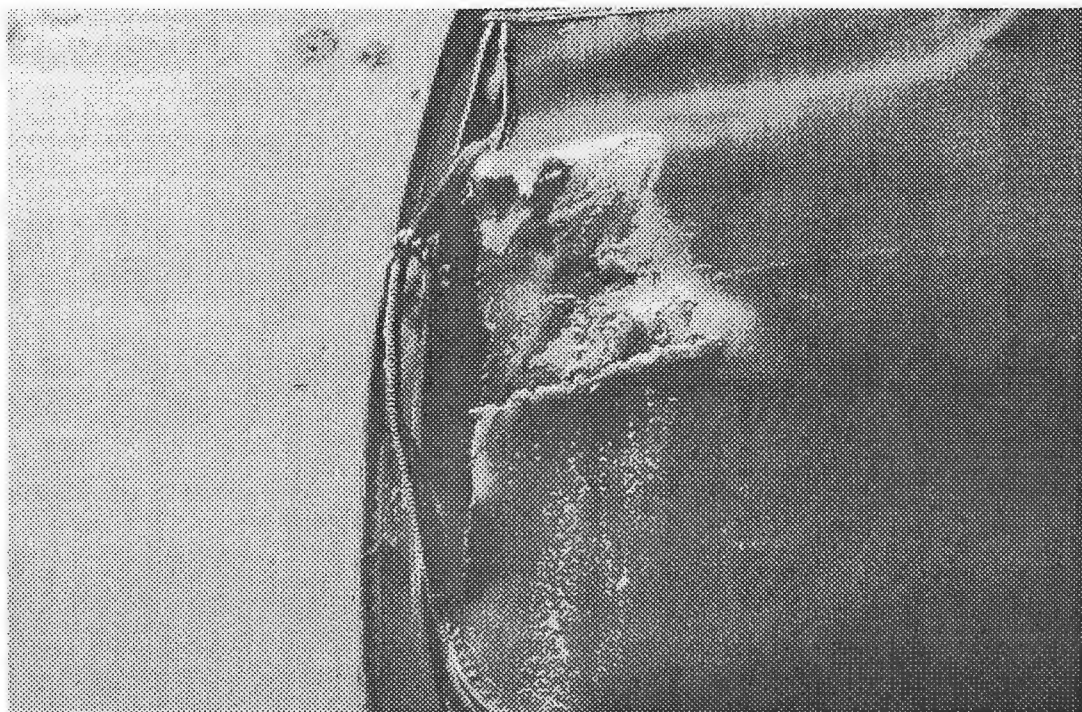
Northwest began telephoning Northwest management at all of the destination airports, initially focusing on the 13 airports receiving flights that had baggage from flight 957. Callers told the management at each airport about the hydrogen peroxide spill, that the spill had injured some Memphis ground crew employees, what first aid to use, and that people handling the baggage should use protective gloves. Northwest recommended that the people who unloaded the airplanes check for wet baggage and condemn and replace any that they found. Northwest also called Northwest's Systems Operations Control (SOC), which telexed, to all Northwest operations offices, station managers, maintenance managers, and control centers, information on the spill and a warning that baggage from flight 957 might be contaminated. The SOC did not warn the pilots of the airplanes that were carrying potentially contaminated baggage from flight 957.

Before flight 7 landed in Seattle, the Northwest employees there knew that the plane might be carrying contaminated baggage, and the baggage handlers, as Memphis had suggested, were protecting their hands with rubber gloves. However, no one in Seattle had independently researched the hazards posed by hydrogen peroxide, and the

Northwest telephone call from Memphis had not mentioned fire hazards. Consequently, no one in Seattle was prepared for the possibility of a fire. The Northwest employees in Seattle had told the local emergency responders about the Memphis spill but had not asked any responders to stand by when flight 7 arrived in case there was a fire.

The baggage handlers reported that when they opened the cargo compartments of flight 7, they found smoke, but no flames, coming from the area of two adjacent suitcases. One handler said the smoke was "like someone blowing on a good cigar." The handlers backed away, and an equipment service employee without any protective equipment climbed into the compartment and retrieved the smoldering suitcases. (See figure 3.) Northwest called the fire department, which doused the suitcases with water. A short time later, the equipment service employee became nauseated and was taken to a local hospital, where he was treated and released.

Northwest's ground operations personnel are trained to react to a fire in an aircraft by calling the fire department from a safe location and by closing exterior doors to prevent the spread of fire inside the aircraft. Some ground operations personnel are not trained in what actions to take when hazardous materials are spilled in cargo compartments.



**Figure 3.** One of the damaged suitcases discovered in Seattle.

## Events Preceding Incident

The passenger who had checked the ice chest at Orlando was a nurse. She had bought the hydrogen peroxide containers several years earlier and stored them unopened at an assisted care facility for the elderly in Fort Pierce, Florida, that she had once owned. Before her trip on flight 957, she had packed the two plastic bottles of hydrogen peroxide in a plastic ice chest with some sand and a bag of rolls.

She arrived at the airport at 0600 eastern standard time (EST); the flight was scheduled to depart at 0630 EST. She attempted to check seven items, including the ice chest, at Northwest's roadside skycap service. According to the skycap, he had been reluctant to check the bags because Northwest allows a passenger to have only two items checked without paying additional fees. He had told her that the fees must be paid at the ticket counter inside the terminal, but she explained that she was late and persuaded him to check all seven of her items. She tipped him \$20 dollars and rushed off.<sup>6</sup>

The skycap said that he had asked the woman whether the ice chest contained dry ice, a hazardous material with special limitations in air transportation. She did not declare that there were any hazardous materials in her baggage<sup>7</sup> and later told investigators that she was not aware that hydrogen peroxide was a hazardous material. She checked in with Northwest at the gate and left Orlando on flight 957. There were no reports of incidents or injuries at the Orlando airport involving her baggage. Northwest hazardous materials training instructs a person accepting passenger baggage to specifically ask passengers what is in an ice chest.

## Hazardous Materials Information

According to the Hazardous Materials Regulations of the Department of Transportation (DOT),<sup>8</sup> a 35-percent solution of hydrogen peroxide is an oxidizer with corrosive properties. The proper shipping name for the product is "hydrogen peroxide, aqueous solution with not less than 20 percent but not more than 40 percent hydrogen peroxide." A package containing hydrogen peroxide must be marked and labeled and have a shipping paper that describes the material and certifies that the shipment conforms to DOT requirements. A selection of applicable requirements that are intended to prevent or limit spillage of hazardous materials follows:

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<sup>6</sup> Northwest management indicated that the skycap was a Northwest employee and was authorized to collect the fees for extra baggage. Northwest took disciplinary action against the skycap.

<sup>7</sup> A search of her other baggage in Seattle revealed other undeclared hazardous materials, including small arms ammunition, an aerosol can of lubricant (a flammable gas), and a tube of gun oil (a combustible liquid).

<sup>8</sup> Title 49 *Code of Federal Regulations* (CFR) Subchapter "C."

The maximum quantity of 20- to 40-percent hydrogen peroxide that may be shipped aboard a passenger aircraft in a single package is one liter (0.26 gallons).

Hydrogen peroxide must be shipped in combination packaging. Several different forms of combination packaging are allowed for this product, including a plastic inner packaging inside a plastic outer packaging. However, the inner packaging must meet certain minimum requirements to prevent leakage, and the outer packaging must be manufactured, tested, and marked to DOT packaging specifications (see 49 CFR 173.202).

When transported by aircraft, the plastic inner packaging must be enclosed by a tightly closed metal receptacle before it is placed in the outer packaging.

Closures on the inner packaging must be upright, and opposite sides of the outer packaging must have arrows indicating the correct upright direction.

Vero Chemical Distributors, Inc., the company that labeled the gallon bottles of hydrogen peroxide, said that it sells its product only to local customers and does not prepare or package the product to be transported in accordance with the Hazardous Materials Regulations.

*Fire Hazard*—Hydrogen peroxide is a very powerful oxidizing agent that can oxidize all organic compounds and a wide range of inorganic ones. It is not flammable, but it can readily cause other materials to burn. Natural materials like wood, paper, cotton, and leather are very susceptible to fire when exposed to hydrogen peroxide. These reactions are enhanced when the material contains dirt, especially metallic compounds of copper, silver, or mild steel.<sup>9</sup>

Hydrogen peroxide is generally shipped in solution with water. Solutions range from those used as an antiseptic (2 to 3 percent), through industrial strengths (27.5 to 70 percent), to concentrations used in specialized industry, military, and rocket propulsion (86 to 100 percent). The more concentrated the solution, the more reactive it is.

If a hydrogen peroxide solution is allowed to evaporate, the water evaporates more quickly than the hydrogen peroxide does, causing the solution to become more concentrated. As a hydrogen peroxide solution becomes more concentrated and is exposed to organic materials and dirt or metallic compounds, the hydrogen peroxide begins to

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<sup>9</sup> Mild steel is a carbon steel with a maximum of about 0.25 percent carbon.

decompose. This decomposition results in an exothermic reaction<sup>10</sup> and the release of oxygen, which will support combustion.

On February 3, 1988, American Airlines flight 132, a McDonnell Douglas DC-9-83, had an in-flight fire while en route to Tennessee from Texas.<sup>11</sup> The fire eventually breached the cargo compartment, and the passenger cabin floor over the middle cargo compartment was charred. The investigation determined that the fire had been caused by an undeclared and improperly packaged shipment of hydrogen peroxide. Further, according to the incident data base of the Research and Special Programs Administration, from 1995 through 1999, there were nine incidents involving hydrogen peroxide in air transportation.

*Material Safety Information*—Safety Board investigators reviewed several material safety data sheets about hydrogen peroxide, including those provided by Northwest. Most of the sheets warned that people who handle hydrogen peroxide solutions need protective clothing and that contaminated clothing should be laundered before being reused. The sheets, however, did not explain the reasons for the warnings, and only about half of the sheets warned that allowing the product to dry on clothing or combustible materials may cause a fire.

## Handling of Mail

The post office employee who picked up the wet mail sacks called a post office safety officer in the central Memphis post office to report that the mail sacks were contaminated with a liquid. The safety officer told him to isolate the mail sacks on the docks until he, the safety officer, arrived. By the time he arrived, the contamination had been identified as hydrogen peroxide. He then said that the mail should be dumped from the nylon sacks into large open wire bins and allowed to dry outside. That evening, after the mail had dried outside, it was shipped by ground transportation to its destination, Kansas City, Missouri. The safety officer said that he was familiar with hydrogen peroxide and did not refer to any specific information on the hazards or properties of the chemical in determining the actions to be taken.<sup>12</sup> The Postal Service did not have any subsequent incidents involving the contaminated mail.

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<sup>10</sup> A chemical reaction that results in the generation and release of heat.

<sup>11</sup> National Transportation Safety Board. 1988. *In-flight Fire, McDonnell Douglas DC-9-83, N569AA, Nashville Metropolitan Airport, Nashville, Tennessee, February 3, 1988*, Hazardous Materials Incident Report NTSB/HZM-88/02. Washington, D.C.

<sup>12</sup> Postal Service training material about hazardous materials emergency response states that postal employees responding to a hazardous materials spill should determine the hazards of the material by using material data safety sheets and other information.



## **Postincident Actions**

The Federal Aviation Administration has initiated action against the passenger for violating the Hazardous Materials Regulations.

## **Probable Cause**

The National Transportation Safety Board determines that the probable cause of the release of undeclared hazardous material aboard Northwest Airlines flight 957 was the passenger's failure to properly package and identify the hazardous material and inadequate inquiries from the Northwest Airlines agent about the contents of the cooler offered by the passenger. Contributing to the consequences of the release were inadequate carrier procedures, which allowed contaminated baggage to be transferred to other aircraft.

## **Recommendations**

As a result of this accident, the National Transportation Safety Board makes the following safety recommendations:

### **to the Federal Aviation Administration:**

Develop, with the assistance of the Hydrogen Peroxide Safety Producers Committee, and distribute to carriers guidance about the difficulty of identifying a hydrogen peroxide spill and about the danger of allowing hydrogen peroxide to dry on organic materials (including paper, fabric, cotton, and leather), which may result in a fire. (A-00-51)

Issue guidance to air carriers about the need to isolate baggage and cargo that have been involved with a hazardous materials spill until it can be determined which items have been contaminated and what measures are necessary to prevent further contamination of baggage and aircraft or other hazards (such as fire or poisoning). Then require principal operations inspectors to review and amend, as necessary, air carrier manuals to ensure that air carrier procedures are consistent with this guidance. (A-00-52)

Issue guidance to air carriers about the need to notify pilots in flight when baggage and cargo that are believed to have been involved in a hazardous materials spill have been placed on their aircraft; notifying the pilots includes clearly identifying the hazards posed by the material

involved in the spill and the procedures that the pilots should take. Then require principal operations inspectors to review and amend, as necessary, air carrier manuals to ensure that air carrier procedures are consistent with this guidance. (A-00-53)

**to the U.S. Postal Service:**

Reinforce the training provided to your hazardous materials emergency responders concerning the need to use technical information, including material safety data sheets, about the hazards and the chemical properties of materials when responding to a spill instead of relying solely on memory or previous experience.(A-00-54)

**to the Air Transport Association:**

Inform your members about the Memphis incident and make them aware of the following: the difficulty of identifying a hydrogen peroxide spill, the danger of allowing hydrogen peroxide to dry on organic materials, the need to isolate baggage and cargo that have been involved with a hazardous materials spill until it can be determined which items have been contaminated and what measures are necessary to prevent further contamination of baggage and aircraft or other hazards (such as fire or poisoning), and the need to notify pilots in flight when baggage and cargo that are believed to have been involved in a hazardous materials spill have been placed on their aircraft (such notification includes informing the pilots clearly about the hazards presented by the material involved in the spill and the procedures that the pilots should take). (A-00-55)

**to Northwest Airlines, Inc.:**

Amend your emergency response procedures and training to include the importance of isolating baggage and other cargo that has been involved with a hazardous materials spill until it can be determined which items have been contaminated and what measures are necessary to prevent further contamination of baggage and aircraft or other hazards (such as fire or poisoning). (A-00-56)

Amend your emergency response procedures and training to include notification to pilots in flight when baggage and cargo that are believed to have been involved in a hazardous materials spill have been placed on their aircraft; notifying the pilots includes clearly identifying the

hazards posed by the material involved in the spill and the procedures that the pilots should take. (A-00-57)

Reinforce the training provided to ground operations and maintenance personnel on actions to take for a suspected fire in an aircraft cargo compartment. Also for those employees, review and modify, as appropriate, procedures and training for a suspected hazardous materials spill in an aircraft cargo compartment. (A-00-58)

**to the Hydrogen Peroxide Safety Producers Committee:**

Urge your members to revise their material data safety sheets for hydrogen peroxide to include warnings about the dangers of allowing hydrogen peroxide to dry on organic materials (including paper, fabric, cotton, and leather), which may result in a fire. (A-00-59)

Assist the Federal Aviation Administration in developing guidance for air carriers about the difficulty of identifying a hydrogen peroxide spill and about its hazards. Include, at a minimum, the fact that hydrogen peroxide is colorless, has little odor, and may be mistaken for water; the guidance should also warn of the danger of allowing hydrogen peroxide to dry on organic materials (including paper, fabric, cotton, and leather), which may result in a fire. (A-00-60)

**Adopted May 17, 2000**