



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 8, 2000

In reply refer to: A-00-59 and -60

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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address the adequacy of emergency response guidelines, procedures, and training for responding to a hydrogen peroxide spill. The recommendations are derived from the Safety Board's investigation of the October 28, 1998, spill of hydrogen peroxide in a cargo compartment on Northwest Airlines (Northwest) flight 957 while it was en route from Orlando, Florida, to Memphis, Tennessee, and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued ten safety recommendations, two of which are addressed to the Hydrogen Peroxide Safety Producers Committee. Information supporting the recommendations is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.

On the morning of October 28, 1998, 2 gallons of a 35-percent hydrogen peroxide solution in water, an oxidizer with corrosive properties, spilled in a cargo compartment of Northwest flight 957, a passenger-carrying airplane en route from Orlando to Memphis. 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.

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.

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 incident were inadequate carrier procedures for handling a hazardous materials cargo spill.

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.¹

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.² She did not declare that there were any hazardous materials in her baggage³ 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.

¹ 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.

² Northwest hazardous materials training specifically addresses questioning passengers about hazardous materials in ice chests.

³ 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).

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.⁴ 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.⁵

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.

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 airplane. 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 airplane was not affected by the incident, the pilot of flight 7 departed as scheduled.

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. 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 about hydrogen peroxide as references. Northwest stated that it also contacted the Minnesota Poison Control Center.⁶ (While there is no record of the information provided by the center, 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.) The information gathered described some of the hazards posed by hydrogen peroxide, but much 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.

⁴ 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.

⁵ 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.

⁶ At the time of the incident, the Minnesota Poison Control Center was under contract to Northwest to provide hazardous materials information.

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.⁷ 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 decompose. This decomposition results in an exothermic reaction⁸ and the release of oxygen, which will support combustion.

In the time between the discovery of the spill and the identification of the hazardous material, an undetermined number of bags potentially contaminated with hydrogen peroxide were transferred to 13 other Northwest aircraft for flights that departed Memphis, including flight 7 to Seattle. Northwest began making calls to Northwest management at all of the destination airports, initially focussing on airports receiving flights that had baggage transferred from flight 957. Callers provided information that focussed on the injuries to the Memphis ground crew, first aid, and the need to use protective gloves when handling the baggage, and not on the fire hazard. It was recommended that people unloading the airplane check for wet baggage and, if it was discovered, condemn and replace it. A call was also made to Northwest's Systems Operations Control, which telexed information on the spill and a warning about potentially contaminated baggage to all Northwest operations offices, station managers, maintenance managers, and control centers. No similar warnings were sent to the pilots of the aircraft containing potentially contaminated baggage.

Before flight 7 landed in Seattle, the Northwest employees there knew that the airplane 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. Northwest called the fire department, which drowned 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.

The 1996 *North American Emergency Response Guidebook* refers the reader to Guide 140, "Oxidizers," when dealing with a hydrogen peroxide aqueous solution with not less than 20 percent but

⁷ Mild steel is a carbon steel with a maximum of about 0.25 percent carbon.

⁸ A chemical reaction that results in the generation and release of heat.

not more than 60 percent hydrogen peroxide. Guide 140 is about oxidizers in general, not about hydrogen peroxide specifically. The guide does not warn of the fire hazard caused by hydrogen peroxide drying on materials; however, not all oxidizers are shipped in solution with water, nor do they necessarily concentrate and become more reactive when they dry. As the guidebook states:

It is primarily a guide to aid first responders in quickly identifying the specific or generic hazards of the material(s) involved in the incident, and protecting themselves and the general public during the initial response phase of the incident...It is not intended to provide information on the physical or chemical properties of dangerous goods.

The Memphis fire department obtained specific information on hydrogen peroxide from an unidentified material data safety sheet for the material. Several material safety data sheets for hydrogen peroxide, including those provided by Northwest, were reviewed by investigators. Only about half the sheets reviewed warned that the product drying on clothing or combustible materials may cause a fire. The Safety Board concludes that, given the use of material safety data sheets by emergency responders and the potential for fire caused by hydrogen peroxide drying on certain materials, all material safety data sheets about hydrogen peroxide should include a warning about the danger. Therefore, the Safety Board believes that the North American Hydrogen Peroxide Safety Producers Committee should urge its members to revise their material data safety sheets about 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.

The initial reaction of the baggage handlers to the clear water-like liquid in the cargo compartment of flight 957 was not unreasonable, given Northwest's indication that there are frequent spills of water from ice chests and tropical fish shipments. However, the Safety Board concludes that hydrogen peroxide presents a serious hazard to air transportation because it can be mistaken for water and can cause a fire if it is allowed to dry on cargo or baggage. Therefore, the Safety Board has recommended that the Federal Aviation Administration (FAA) develop 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.

Given the unique knowledge of hydrogen peroxide that the North American Hydrogen Peroxide Safety Producers Committee has, the Safety Board believes that the committee should assist the FAA in developing guidance for air carriers about the difficulty of identifying a hydrogen peroxide spill and about its hazards. The guidance should explain, at a minimum, 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.

The FAA has initiated enforcement action against the Northwest passenger for violations of the Hazardous Materials Regulations.⁹

⁹ Title 49 *Code of Federal Regulations* (CFR) Subchapter "C."

As a result of this investigation, the National Transportation Safety Board recommends that 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)

The Safety Board also issued safety recommendations to the Federal Aviation Administration, the U.S. Postal Service, Northwest Airlines, Inc., and the Air Transport Association. In your response to the recommendations in this letter, please refer to Safety Recommendations A-00-59 and -60. If you need additional information, you may call (202) 314-6170.

Chairman HALL and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman