



Lq 2237

National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: May 30, 1990
In reply refer to: A-90-78 and -79

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July, 19, 1989, a McDonnell Douglas DC-10-10, operated by United Airlines as flight 232, en route from Denver, Colorado, to Chicago, Illinois, experienced an in-flight emergency following the fragmentation and separation of the No. 2 engine fan disk. The airplane crashed during an attempted emergency landing on runway 22 at Sioux Gateway Airport, Sioux City, Iowa.

During the ground impact sequence, the airplane separated into sections and portions burned. The center section of the airplane, which contained most of the passengers, came to rest inverted in a cornfield adjacent to runway 17 and 3,700 feet from the initial impact on runway 22. Of the 296 persons on board the airplane, 110 passengers and 1 flight attendant were fatally injured. Autopsies revealed that 35 passengers died of smoke inhalation, including 24 without traumatic blunt force injuries. The others who were fatally injured died of multiple injuries from blunt force impact. Of the remaining 185 persons on board, 47 sustained serious injuries, 125 sustained minor injuries, and 13 were not injured.

The Safety Board's continuing investigation of this accident has disclosed problems that affected the safety and survivability of infants ^{1/} and small children. Among the 285 passengers on board were 3 infants and 1 small child--ranging

^{1/}Definition of "infant" is not standard among transportation-related organizations: definitions vary based on different criteria including age, weight, and height. The National Highway Traffic Safety Administration defines an infant as under 1 year old and toddlers from 1 to 4 years old. The Society of Automotive Engineers' Aerospace Recommended Practice (ARP) 1469, "Restraint Device for Infants," refers to infants as under 20 pounds and/or too young to sit up; ARP 766A, "Restraint Device for Small Children," refers to children as being between 20 to 40 pounds. Throughout this letter, the term "infant" refers to aircraft occupants who have not reached their second birthday.

in age from 11 months to 26 months--who were being held by adults. One infant was fatally injured; two infants and the small child sustained minor injuries. The three who survived were located in "B Zone" where 91 percent of the occupants sustained minor injuries.

During the preparation for the emergency landing, parents were instructed to place their "infants" on the floor and to hold them there when the parent assumed the protective brace position. The four "in-lap occupants" were held on the floor by adults who occupied seats 11F, 12B, 14J, and 22E. Investigators do not know what happened to the 26-month-old child at 12B during the impact sequence. Investigators do know that the child sustained an abrasion to his left hand and that his father was not injured. The 11-month-old infant at seat 11F was pulled from her mother's grasp during the impact, and the parents were unable to find her when the airplane stopped. She was found by a passenger who re-entered the cabin when he heard a baby crying. The infant sustained an abrasion under her left eye; the mother was not injured.

The woman in 14J said there were two extremely hard impacts before the airplane rolled to the right. She stated, "My son flew up in the air and I managed to grab hold of him around the waist. He struck his head [on the side of the cabin wall] several times before the plane came to a stop and several times I had to pull him back into my arms as he slid out of my grip." Her 23-month-old son sustained a scalp contusion, and she sustained a contusion to her right ear.

The woman seated in 22E stated that she assumed the brace position with her 23-month-old son on the floor between her legs. During the impact, she was jolted to an upright position and she saw her son's body "flying" down the right aisle toward the rear of the cabin. When the airplane stopped, she could not get to the back of the cabin where she thought her son was. Smoke immediately entered the cabin and hindered her breathing; she was urged by other passengers to exit. She was not injured, but her son died of asphyxia secondary to smoke inhalation.

The problems experienced by these three parents graphically illustrate the impossibility of holding onto an infant during a crash. Present regulations of the Federal Aviation Administration (FAA) allow an occupant who has not reached his/her second birthday to be held in the arms of an adult. Researchers at the FAA's Civil Aeromedical Institute, however, have vividly demonstrated with anthropomorphic dummies of varying weights that holding onto an infant is difficult, even in accidents involving the minor inertia loads specified in 14 CFR 25.561.

The Safety Board is concerned that the FAA has not adequately addressed the issue of "infant" occupant protection. Investigations have repeatedly shown problems with the safety and survivability of unrestrained infants and small children who have been involved in survivable crashes or incidents in which turbulence was encountered. For example:

On January 4, 1972, a National Airlines B-747 encountered turbulence near Lake Charles, Louisiana. An unrestrained 6-month-old infant struck an overhead compartment and sustained a facial contusion.

On December 28, 1978, a United Airlines DC-8 crashed in Portland, Oregon. Among the passengers were six infants and six small children between the ages of 25 months and 8 years. Two infants and one child sustained fatal injuries. The Safety Board subsequently recommended that the FAA "expedite research with a view toward early rulemaking on a means to most effectively restrain infants and small children during in-flight upsets and survivable crash landings" (A-79-63).

In response to the recommendation, the FAA issued Technical Standard Order (TSO) C-100 in 1982, which provided for the use of some automobile infant restraint devices on airplanes. On February 24, 1983, the Safety Board issued Recommendation A-83-1 to the FAA to "Amend TSO C-100 to permit the use of any infant or child restraint device bearing a label in conformance with 49 CFR 571.213, S5.5.2 (e) during takeoff, landing, and in-flight operations, until such time as the Federal Aviation Administration and the National Highway Traffic Safety Administration issue standards for devices acceptable for use in both motor vehicles and aircraft." Recommendation A-83-1 superceded A-79-63.

In response to A-83-1, the FAA issued TSO C-100a in March 1985, which described child/infant seats acceptable for use aboard aircraft: those manufactured after February 26, 1985, that also complied with applicable Federal Motor Vehicle Safety Standards. Some seats manufactured prior to February 26, 1985, were also acceptable; those seats were listed in Advisory Circular (AC) 91-62, "Use of Child/Infant Seats in Aircraft," issued February 26, 1985. The circular provided information to assist air carriers on the proper use of child/infant seats aboard aircraft. The circular also made clear that the use of child/infant seats was not required by the FAA and that their use was at the discretion of the airline.

Since the amended TSO C-100a and AC 91-62 were made effective in 1985, the Safety Board completed investigations of two airplane accidents in which infants were on board:

On July 13, 1986, an Eastern Airlines A-300 encountered turbulence as it descended for landing at the Miami International Airport. The seat belt sign was on and the captain had made an announcement about expected turbulence. Of those on board, 20 passengers and 8 flight attendants sustained minor injuries, and 2 passengers sustained serious injuries. An unrestrained 7-month-old infant was propelled upward and fell on an armrest of the seat in front of the infant's parents. The infant sustained a minor injury: a contusion to the left temple.

On November 15, 1987, a Continental Airlines DC-9 crashed during takeoff from Denver, Colorado. Of those on board, 3 crewmembers and 25 passengers sustained fatal injuries. A 6-month-old in-lap infant died of multiple injuries from blunt force impact including basilar skull fractures and injuries to the thorax. His mother survived with serious injuries.

During the Safety Board's public hearing that convened October 30, 1989, in Sioux City, Iowa, the Air Transport Association (ATA) testified that its member air carriers would be encouraged to promote the use of child safety seats that are acceptable to the FAA on board carrier airplanes. ATA subsequently has been in contact with manufacturers of child safety seats to determine if the size of the child safety seats could be reduced to make them more compatible with aircraft passenger seats. On February 22, 1990, the ATA petitioned the Federal Aviation Administration to require the use of child safety seats on transport category airplanes.

In testimony at the public hearing, the FAA stated that a review of regulatory history had failed to identify the reason for permitting occupants who had not reached their second birthday to be held in the lap of an adult. The FAA also stated that about 1 percent of the passengers enplaned on U.S. air carriers hold infants. When the FAA witness was asked to identify the best way for parents to protect their infants, the witness stated that infants were best protected in "an FAA-approved infant/child restraint system that was properly installed in a seat." The FAA also testified that the agency was currently engaged in a rulemaking regarding infant restraint. The FAA issued a Notice of Proposed Rulemaking (NPRM) 90-6, "Miscellaneous Operational Amendments," on February 28, 1990; the Safety Board has reviewed the proposed rule, which would prohibit air carriers from denying the use of approved child safety seats, but not require that they be used. The Safety Board does not believe that voluntary use of child safety seats is an appropriate means of ensuring occupant safety.

The Safety Board is currently investigating two more accidents that involved the safety and survival of infants and small children:

On January 20, 1990, an American Airlines DC-10 encountered turbulence near San Juan, Puerto Rico. The seat belt sign was on. Preliminary investigation revealed that an unrestrained 7-week-old infant sustained serious head injuries and was hospitalized with a fractured occipital bone, subdural hemorrhage, and intra-cranial bleeding. The infant was the only occupant who sustained serious injuries.

On January 25, 1990, an Avianca Airlines B-707 crashed in Cove Neck, New York, with 149 passengers and 9 crewmembers. Among the passengers were 7 infants under 2 years old. A 4-month-old infant sustained fatal injuries. The six other infants, who were between the ages of 4 months and 18 months, sustained serious injuries.

The Safety Board has found confusion among parents of infants regarding the use of child safety seats considered acceptable by the FAA. For example, all child safety seats manufactured after February 26, 1985, contain a label that states: "This restraint is certified for use in Motor Vehicles and Aircraft." Although the FAA has made available a brochure entitled "Child/Infant Safety Seats Acceptable for Use in Aircraft," few parents apparently are aware that the brochure encourages the use of child safety seats in aircraft. Further confusion exists because some air carriers permit the child safety seats to be occupied by small children and infants while other air carriers deny their use. Thus, in the case of connecting flights with different air carriers, a child safety seat might be allowed on one portion of the trip but not on another portion.

Confusion also exists among air carrier personnel about whether automobile child safety seats can be used: parents have sometimes been told that the FAA prohibits use of child safety seats even though the seats contain the label that states they can be used in aircraft, and some parents have been told that they can use the seats during flight, but not during takeoff and landing. Additional problems are encountered by airline personnel in determining the age of in-lap occupants. This problem was illustrated in the Sioux City accident when a 26-month-old child was carried as an in-lap infant. There was confusion among some passengers during the preparation for the emergency landing about which "infants" to place on the floor. The passenger in seat 17E stated that the woman next to him apparently considered, but then rejected, taking her 27-month-old son out of his seat (seat 17G) where he was secured by a lapbelt to place him on the floor in response to instructions given over

the public address system. The 27-month-old boy remained secured in seat 17G by the lapbelt during the impact and was not injured. A 3-year-old was taken from seat 27D by her father who was in seat 27C and placed on the floor. Both the father and daughter died of smoke inhalation.

The Safety Board has long promoted the use of safety seats in automobiles and has vigorously endorsed legislation to require their use. Fortunately, all 50 States and the District of Columbia now have child passenger protection laws. Morbidity statistics clearly show that small children and infants who are properly restrained in a safety seat that is correctly installed in an automobile have far better protection from death and serious life-threatening injuries than children and infants who are not restrained.

The Safety Board believes that, in addition to the increased risk of injury or death, unrestrained occupants jeopardize the safety of other passengers. In its investigation of the DC-10 accident that occurred in Sioux City, Iowa, the Safety Board noted that the unrestrained infant who was killed weighed 35 pounds. The Safety Board believes that the unrestrained status represents a major contradiction in the FAA regulations that require all other "items of mass" such as carry-on baggage to be stowed for take-off and landing; persons younger than 2 years may be unrestrained and thus pose a threat to other passengers in the event of an accident or during an in-flight encounter with turbulence.

The FAA has permitted infants to be held during landing and takeoff because there was no method to adequately protect them from turbulence and crash impacts prior to the introduction of child safety seats. As early as January 1, 1981, however, the FAA recognized the benefits of child safety seats and encouraged their use on board aircraft. The Safety Board is disappointed that in spite of the FAA's own research, the demonstrated benefits of child safety seats in automobiles, and the availability of child safety seats acceptable to the FAA as early as 1981, the FAA has failed to require their use on aircraft and has even allowed airlines to deny their use.

FAA testimony at the public hearing in Sioux City, Iowa, indicates that the FAA arbitrarily selected 2 years as the age cutoff for the requirement for an occupant to be restrained; the selection was not based on scientific or empirical data. The Safety Board believes that the use of child safety seats should be required for children below the weight of 40 pounds and under the height of 40 inches. The Safety Board also believes that the FAA should conduct research to determine the size at which a child is adequately protected by aircraft seatbelts and, if needed, determine a method of restraining children who are too large for child restraint devices while too small for aircraft seatbelts. Infants and small children should be afforded equal

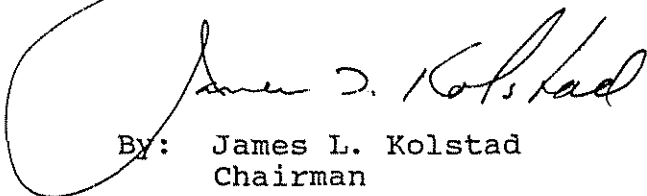
or greater protection from death and injury during crash impacts and turbulence as afforded other persons on board commercial and general aviation aircraft.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Revise 14 CFR 91, 121 and 135 to require that all occupants be restrained during takeoff, landing, and turbulent conditions, and that all infants and small children below the weight of 40 pounds and under the height of 40 inches be restrained in an approved child restraint system appropriate to their height and weight. (Class II, Priority Action) (A-90-78)

Conduct research to determine the adequacy of aircraft seatbelts to restrain children too large to use child safety seats and to develop some suitable means of providing adequate restraint for such children. (Class II, Priority Action) (A-90-79)

KOLSTAD, Chairman, COUGHLIN, Acting Vice Chairman, LAUBER, and BURNETT, Members, concurred in these recommendations.



By: James L. Kolstad
Chairman