

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

ISSUED: October 4, 1979

Forwarded to:

Honorable Langhorne M. Bond  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)  
A-79-76 through -78

The violent decelerative forces generated in an aircraft accident cause the upper torso of passengers who are restrained solely by seatbelts to swing forward and strike other objects. This reaction often results in serious or fatal injuries in otherwise survivable crashes. An FAA document <sup>1/</sup> suggests the upper torso of passengers restrained solely by seatbelts will jackknife forward if decelerative forces exceed 1.5 to 2.0 g's.

This premise was illustrated dramatically in a recent crash landing of a New York Airways Sikorsky S-61L helicopter on April 18, 1979, at Newark Airport, New Jersey. Fifteen passengers and three crewmembers were on board. Three passengers received fatal crash injuries, and 10 passengers and all 3 crewmembers were injured seriously. Two male passengers, who reportedly took a brace position before the crash, were seated in the forward cabin where all of the fatalities and most of the severe injuries occurred; yet, both individuals received only minimal head or chest trauma.

The flight attendant had prewarned the passengers to expect a hard landing. However, she did not direct them to assume any kind of a brace position because there was not enough time after the tail rotor separated. There was no specific requirement in the flight manual to give such a directive; moreover, there was no instruction on the passenger briefing cards telling them to take a brace position.

<sup>1/</sup> "General Aviation Structures Directly Responsible for Trauma in Crash Deceleration," J. J. Swearingen, FAA CAMI, Oklahoma City, Oklahoma, FAA Report AM-71-3, January 1971.

Data from three other recent aircraft accidents also suggest that passengers who lean forward or assume a brace position before a crash receive significantly less trauma than do other passengers. While the three supporting examples involve the DeHavilland DHC-6 Twin Otter aircraft, we emphasize that they were selected solely because the survivor injury experience succinctly illustrates the differences between injuries incurred by occupants who took a brace position and those who did not.

The first accident involved an Atlantic City Airlines DeHavilland DHC-6 Twin Otter commuter aircraft which crashed while on an approach to Cape May County Airport, New Jersey, on December 12, 1976. Eight passengers and two crewmembers were on board. The copilot and three passengers died. One 19-year old male passenger, seated in the second row of seats, had lowered his head between his legs because he was airsick. He reported that there was no warning before the crash. He survived with minimal injuries while the three passengers seated beside him and in the row in front of him died from crash trauma to the head and chest.

The second accident involved a Rocky Mountain Airlines DeHavilland DHC-6 Twin Otter which crashed into snow-covered mountainous terrain near Steamboat Springs, Colorado, on December 4, 1978. Twenty passengers and two crewmembers were on board. The captain and 1 passenger died from crash injuries while the first officer and 13 other passengers received serious crash injuries. No crash warning was given to the passengers. One 26-year-old female passenger, seated in the center of the passenger cabin, took a brace position because she was frightened and suffered only minor bruises and abrasions. Several other passengers seated around her suffered significant head injuries, including skull fractures, lacerations, and brain concussions.

The third accident involved a Downeast Airlines DeHavilland DHC-6 Twin Otter commuter aircraft which crashed on May 30, 1979, during an approach to Knox County Regional Airport near Rockland, Maine. Sixteen passengers and two crewmembers were on board. Fifteen passengers and both crewmembers died from crash injuries. The only survivor, a 16-year-old male passenger, was seated toward the rear of the aircraft. There was no precrash warning, and most of the passengers were sleeping or reading. When the survivor saw that the aircraft was going to crash into trees, he immediately lowered his head and braced his arms and knees against the seat back in front of him. Although his seat, along with most of the other seats, separated upon impact, he suffered only a fractured leg and wrist and a scalp wound.

The Safety Board believes that these accidents illustrate the importance of having passengers assume an appropriate brace position in a potential accident situation. However, there are a number of important factors to consider in choosing an appropriate brace position: (1) various types of seat designs, such as short versus high backs and fixed versus folding backs; (2) various seating arrangements, such as forward versus aft-facing and side-facing units; and (3) differences in seat pitch.

The Safety Board is aware of only one study (of limited scope) which has addressed this subject. In 1967, the Civil Aeromedical Institute (CAMI) conducted a sled impact study with anthropomorphic dummies seated upright. The dummies were studied in two brace positions: (1) leaning forward grabbing the ankles, and (2) leaning forward with the head resting on crossed hands placed on the seat back in front of the dummy. The study only examined forward-facing, 35-inch pitch airline-type seats.

Air Carrier Operations Bulletin No. 69-16, dated December 16, 1969, discussed this study and recommended the "arms on seatback" position. However, several different brace positions are currently in use by different U.S. air carriers. Furthermore, many tourist-class and commuter airlines seats currently have a pitch of 29 inches or less, and the design of the seats installed in most commuter-type and helicopter aircraft differ significantly from the airline-type seats examined in the CAMI study.

The Safety Board believes that the FAA should undertake a comprehensive study to determine optimal brace positions for different seat designs and seating arrangements. The FAA also should determine the best method of informing passengers of the appropriate brace position in potential emergency landing situations.

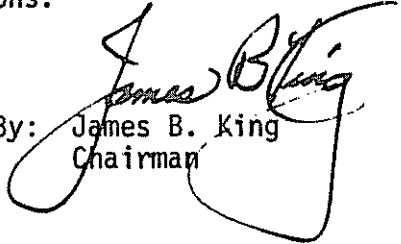
Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish a research project to determine the optimal brace position for various seat designs and seating configurations on aircraft used in passenger-carrying operations. (Class II, Priority Action) (A-79-76)

Issue an Air Carrier Operations Bulletin requesting principal operations inspectors to insure that the training of crewmembers includes information on the appropriate passenger brace position for specific aircraft configurations during potential crash landings. (Class II, Priority Action) (A-79-77)

Issue an Air Carrier Operations Bulletin requiring principal operations inspectors to instruct their assigned air carriers to describe the appropriate emergency brace position on the passenger briefing card and to require that preflight briefings include a reference to the proper brace position. (Class II, Priority Action) (A-79-78)

KING, Chairman, DRIVER, Vice Chairman, McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

By:   
James B. King  
Chairman