A06 1394

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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Forwarded to:
Honorable J. Lynn Helms
Administrator
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-81-139 through -143

A study 1/ by the National Transportation Safety Board has shown that since 1970, almost 60 percent of the large transport aircraft involved in survivable and partially survivable major accidents and incidents investigated by the Safety Board have exhibited failures of cabin furnishings. Of the more than 4,800 passengers and crew involved in these accidents, over 1,850 were injured or killed. The Safety Board believes that many of these injuries and deaths would have been prevented had cabin furnishings not failed, particularly in accidents involving fire (about 46 percent).

The regulations dealing with the ability of an aircraft to withstand crash forces are found in two different subparts of 14 CFR 25- Airworthiness Standards: Transport Category Airplanes. For cabin crashworthiness and occupant protection, the specific regulations are 14 CFR 25.561, Emergency Landing Conditions--General; 14 CFR 25.785, Seats, berths, safety belts, and harnesses; 14 CFR 25.787, Stowage compartments; and 14 CFR 25.789, Retention of items of mass in passenger and crew compartments and galleys.

Regulation 14 CFR 25.561, which is the foundation for the other three regulations, has not been upgraded in about 30 years. Although design and testing technology have improved greatly, no changes have been made. The Safety Board believes that the fact that crashworthiness is treated in separate subparts of 14 CFR 25 and not in one consolidated section may have contributed to the lack of progress in this extremely important area.

The Safety Board does not believe that occupants of large transport aircraft are protected adequately in a minor crash landing. This study has shown that aircraft occupants are being injured, trapped, and killed in survivable accidents. Many deaths and injuries are directly attributable to failures of seats and cabin furnishings. After failing, seat systems and other cabin furnishings trap and incapacitate occupants or become obstacles to rapid egress, thereby increasing greatly the potential for fatalities caused by postcrash factors. However, most of these accidents involved

1/ For more information read, "Special Study: Cabin Safety in Large Transport Aircraft," (NTSB-AAS-81-2)

forces greater than those specified in 14 CFR 25.561. For these cases, the failures are to be expected, even if the minimum standards for design are met. For this reason it is the belief of the Safety Board that 14 CFR 25.561 does not represent adequately the actual accident experience of transport aircraft and that because of this, the passengers and crew are not receiving protection in survivable and partially survivable crashes where it is most needed.

As this study has shown, there is ample evidence from accident cases as well as research to show that human tolerance levels are significantly greater than the FAA officially maintains. The evidence includes a substantial body of work done within the FAA itself. Recognizing that human tolerance limits are considerably higher than the load limits cited in 14 CFR 25.561, two other factors become apparent. First, the current fuselage structures are doing a relatively good job of protecting occupants in crashes with large forces. Second, the limiting factor for survival in these crashes is not human tolerance limits; instead, it is the lethal nature of the environment inside the fuselage.

Many factors, such as aircraft velocity and attitude at impact, affect the loads on an aircraft and ultimately its passengers. The accident cases presented in this study have shown that crash environments are extremely complex and always changing. Forces acting on the aircraft and its interior do not act separately, but in combinations. Therefore, the Safety Board has advocated the use of dynamic testing of items in the tiedown chain and other items of mass in the aircraft cabin. The Aircraft Crash Survival Design Guide 2/describes methods for multiaxis dynamic testing of seat/restraint systems and improved methods for static testing of these systems. Simula Inc. has adapted these methods for different categories of transport aircraft. 3/ The Safety Board believes that this is the best method currently available for dynamic testing, because it involves the components of the seat system reacting together under conditions in which forces are applied simultaneously from different directions. This type of force application represents more accurately the environment in an actual crash.

The Safety Board believes that there is sufficient data currently available to support the upgrading of the occupant crash protection standards in the regulations. Further, the substantial body of knowledge and practical experience in design, construction, testing, and use of crashworthy structures and cabin furnishings can be applied successfully to large transport aircraft, in many cases without substantial penalties in cost or weight and without major modifications to existing structures. The Safety Board also believes that the FAA should concentrate its research efforts on applying available technology to transport aircraft, and in newer areas, such as crashworthiness of composites, instead of continuously reevaluating past work that has been proven valid through actual use for at least 10 years, in both the aviation and automotive industries.

As a result of its special study, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Establish a separate single subpart in 14 CFR 25 which consolidates crashworthiness requirements for transport category aircraft pertaining to areas such as crash models, occupant protection requirements, emergency egress, retention of items of mass, and seat and seat restraint systems. (Class III, Priority Action) (A-81-139)

2/ Aircraft Crash Survival Design Guide, USARTL-TR-79-22, Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia, 1980.

3/ Desjardins, S. P., and D. H. Laananen, "Transport Category Aircraft Seat Strength Proposed Modification to FAR Part 25," TI-8017, Simula Inc., Tempe, AZ, 1980.

Revise the crashworthiness requirements as presently described under Emergency Landing Conditions, 14 CFR 25.561, to eliminate reference to the term "minor crash landing," and to include a descriptive crash model determined from FAA's Transport Aircraft Crashworthiness Program. (Class III, Priority Action) (A-81-140)

Establish and specify in the appropriate subpart of 14 CFR 25, interim standards for the design of seat and restraint systems and cabin furnishings to withstand the multiaxis acceleration levels such as those described by Simula Inc. in its Paper TI-8017. (Class II, Priority Action) (A-81-141)

Establish and specify in the appropriate subpart of 14 CFR 25 and in the related Technical Standard Orders, interim standards for static and dynamic testing of seat/restraint systems, including consideration of warpage or buckling of the attaching structure, and multiaxis dynamic pulses such as those described by Simula Inc. in its Paper TI-8017 and in the Aircraft Crash Survival Design Guide. (Class II, Priority Action) (A-81-142)

Establish an internal procedure which will ensure the periodic review of state-of-the-art crashworthiness design and testing technology and will reflect the improved technology through upgraded standards. (Class II, Priority Action) (A-81-143)

KING, Chairman, and GOLDMAN and BURSLEY, Members, concurred in these recommendations. DRIVER, Vice Chairman, and McADAMS, Member, did not participate.

By: James B. King
for Chairman