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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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Forwarded to:
Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D.C. 20591

SAFETY RECOMMENDATION(S)

A-85-69 through -71

In recent years, the Federal Aviation Administration (FAA) has worked closely with other government agencies and with manufacturers of general aviation airplanes in an effort to improve the crashworthiness of these airplanes. The National Transportation Safety Board continues to encourage these important efforts on the part of the FAA. Unfortunately, comparable efforts have yet to be undertaken for helicopters. Prompt action to upgrade helicopter crashworthiness standards for occupant protection will yield significant improvements in injury prevention and occupant survivability.

To understand the status of helicopter crashworthiness better, the Safety Board contacted members of the FAA's Helicopter Policy and Procedures Staff, helicopter manufacturers, occupant protection equipment suppliers, occupant protection researchers, military helicopter safety specialists, and helicopter owners/operators. The Board reviewed current regulations, accident data, helicopter occupant protection features currently available, and existing and projected developments in crashworthiness technology.

Occupant protection, in the form of requirements for improved crashworthiness, is not a vague technical notion for which adequate data are lacking. The data needed to improve crashworthiness now exist. These same data can be used to provide the information necessary for the FAA to improve the occupant protection standards which govern the design and manufacture of helicopters. Both the Aircraft Crash Survival Design Guide, Volume V--Aircraft Post Crash Survival (Army document USARTL-TR-79-22E) and an earlier version, the Crash Survival Design Guide (USAAVLABS 70-22), contain important proven design information regarding crashworthy structures and fuel systems, energy-absorbing seats and occupant restraints. A report developed by Simula Inc. (DTFA03-81-C-00035), under contract to the FAA, refines this information for use in the general aviation helicopter fleet. The report presents crashworthiness design parameters developed from civilian helicopter accident data. These parameters can be used to develop realistic crashworthiness standards needed for civilian helicopter engineering and design.

Current Army helicopter design practice requires that there be no serious injury to the crew in vertical impacts of up to 42 feet per second. Several of the Army helicopters built to this requirement have civilian counterparts that could meet this impact criterion except that the crash protection features are not required by FAA regulations and, therefore, are not included. FAA regulations require that an occupant have a reasonable chance of escaping serious injury from an emergency landing with an ultimate descent velocity of 5 feet per second. While the Safety Board recognizes that the crash environments likely to be encountered in military operations are more severe than those that would be encountered in most civilian helicopter operations, the Army crashworthiness requirements demonstrate the degree of occupant protection attainable, albeit at a significant price and weight penalty. On the civilian side, the Safety Board notes that the Aerospatial Super-Puma, AS-332, was designed for occupant survivability during vertical impacts of up to 34 feet per second. Thus, the production of marketable vehicles with state-of-the-art crash protection features, considerably in excess of the current FAA requirements, appears feasible.

Since July 18, 1978, the FAA has required that the front seats in all newly manufactured general aviation airplanes be equipped with shoulder harnesses. Additionally, the FAA recently issued a proposed rule that would make shoulder harnesses standard equipment at all seats in newly manufactured airplanes having nine or fewer passenger seats. The Safety Board is aware that the FAA completed action on amendments to 14 CFR Parts 27 and 29 (Rotorcraft Regulatory Review Program; Amendment No. 2) which require only that the front seats of newly certificated helicopters be equipped with shoulder harnesses. While this proposal is a step in the right direction, it will not bring the occupant protection standards for helicopters in line with those being extended to general aviation airplanes. All seats of newly manufactured helicopters should be equipped with shoulder harnesses. Additionally, the draft of the FAA's own study conducted by Simula Inc. clearly points out that the benefits of shoulder harnesses should be available to all occupants of helicopters, not just to the front-seat occupants.

During the Safety Board's review of helicopter crashworthiness, it learned that owners/operators are reluctant to have crash-resistant fuel systems (CRFS) installed on their new helicopters, since performance and maintainability can be degraded. Several of the manufacturers contacted indicated that, although they offered CRFS as an option, relatively few of the systems had ever been purchased. One manufacturer reported that, even when the system was offered as a no-cost option, customers declined the offer. The Safety Board found also that some manufacturers offer CRFS that are off-the-shelf items designed for military applications. While this practice undoubtedly saves engineering time and cost, the military CRFS are designed for small-to-medium firearms ballistic impacts and for operating environments not experienced by civilian helicopters. In effect, owners/operators are discouraged from purchasing CRFS by the weight and cost penalties of military systems and the lack of systems designed for civilian use. The FAA and many airplane manufacturers already have taken steps to incorporate CRFS or its components into general aviation airplanes; a similar effort should be undertaken to improve occupant safety in helicopters.

The U.S. Army has developed and used helicopter crashworthiness design guidelines successfully; the FAA and industry have tested CRFS and have developed the design parameters needed for the development of regulatory standards; and the helicopter manufacturers have designed, constructed, and tested essentially all of the other components necessary to bring civilian helicopters into compliance with the state-of-the-art in helicopter occupant safety. The existing body of knowledge about,

and the technological capabilities for, improving helicopter crashworthiness are sufficient to dictate that state-of-the-art crashworthiness design now be incorporated into the helicopter fleet.

An additional requirement for improving helicopter crashworthiness is the introduction of dynamic impact testing requirements. Such testing of energy-absorbing seats, inertial occupant restraints, crash-resistant fuel systems, and other energy-absorbing structures/systems must be employed to ensure that these devices function as intended. Static tests cannot determine the reaction of such devices in a crash and therefore provide no meaningful information in evaluating their occupant protection capabilities. The Safety Board notes that the FAA and the general aviation manufacturers have taken positive steps toward developing dynamic testing standards and test requirements for fixed-wing aircraft components. The need for dynamic testing is equally valid for helicopter occupant protection features and should be introduced without delay.

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

> Amend the helicopter certification standards contained in 14 CFR Parts 27 and 29 for seats, restraint systems, fuel systems, and structures to incorporate the crash design guidelines developed by the U.S. Army and the civilian helicopter fleet crash loads recommended in the Federal Aviation Administration study (DTFA03-81-C-00035) performed by Simula Inc. (Class II, Priority Action) (A-85-69)
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> Amend 14 CFR Parts 27 and 29 to require that all helicopters manufactured after December 31, 1987, have shoulder harnesses installed at all seat locations. (Class II, Priority Action) (A-85-70)
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> Amend the appropriate subparts of 14 CFR Parts 27 and 29 to require multiaxis dynamic testing for seats, restraint systems, fuel systems, and energy-absorbing structures in newly type-certificated helicopters, and issue corresponding Technical Standard Orders. (Class II, Priority Action) (A-85-71)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in these recommendations.

By: Jim Burnett
Chairman