

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

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(202) 426-8787

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Forwarded to:

Honorable John J. McLucas  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-76-105 through 115

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The National Transportation Safety Board has completed a special safety study titled, "General Aviation Accidents Involving Aerobatics, 1972-1974." This study was prompted by the continued occurrence in recent years of fatal aerobatic accidents. For example, from 1972 through 1974, 105 such accidents resulted in 107 fatalities and 21 serious injuries. The Safety Board believes that, in view of the growing interest in sport aerobatics and the continuing manufacture of airplanes certificated for aerobatic operation, an effort should be made to reduce the number of aerobatic accidents.

The study revealed several areas in which corrective action is necessary:

Aerobatic Training--. There are no regulations which relate directly to the aerobatic curriculum or to a pilot's aerobatic proficiency or experience since there are no certification tests or airman ratings required in connection with the performance of aerobatics. This lack of regulatory influence prompts concern in two related areas: The qualifications of the aerobatic flight instructor, and the unrestricted performance of aerobatic maneuvers by pilots lacking adequate training or experience. The operational implications and safety aspects relating to aerobatics are, in many respects, no less critical than those associated with other areas of operation requiring special training and experience, for example, instrument flight. It is essential, therefore, that all pilots performing aerobatics be thoroughly familiar with all of the approved flight maneuvers, specialized operational techniques, and performance flight characteristics of each make and model airplane flown aerobatically. Moreover, the student aerobatic pilot should not perform solo aerobatic maneuvers without the explicit approval of a qualified aerobatic flight instructor.

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Aerobatic Operations/Airworthiness--. It is recognized that the airworthiness standards in 14 CFR 23 are only minimal standards and that certification in the aerobatic category does not necessarily mean that all types of aerobatic maneuvers may be performed. Moreover, if those aerobatic maneuvers approved for a particular airplane were always flown by experienced aerobatic pilots, the probability of exceeding the design flight envelope would not be significant. Professional aerobatic pilots, however, tend to fly higher strength, higher performance airplanes with relatively few restrictions while the novice aerobatic pilots routinely fly more restricted types. Because of the significant difference in structural limitations between several currently popular aerobatic airplanes, the label "certified for aerobatics" may result in a false sense of security by suggesting or implying an operational or structural capability that does not exist. In view of this fact, the expanded interest in aerobatics, and the performance of increasingly sophisticated aerobatic maneuvers by relatively inexperienced pilots, it is increasingly essential for pilots to completely understand all of the operational implications associated with the performance of aerobatics and for manufacturers and FAA to assure an adequate margin of safety in maneuvers flown by these pilots, particularly inverted maneuvers.

Regulatory requirements for certification in the aerobatic category have been improved and expanded over the years with respect to structural standards which distinguish between type of airplane operation, demonstration of maneuvers for which certification is requested, specifications regarding approved types of aerobatic maneuvers and entry speeds, etc. While applications for original certification are processed in accordance with 14 CFR 23, an airplane previously certificated in the normal category under an older Regulatory Part such as CAR 4A may be currently certificated in the aerobatic category under that same (less rigorous) Part. This does not appear appropriate from an operational, technological, or safety point of view and the number of years in which a product may be certificated in accordance with a particular version of the airworthiness requirements should be limited.

The National Aeronautics and Space Administration has studied the actual flight loads on a number of general aviation airplanes for comparison with their design flight envelopes, including accelerations measured during individual practice, and competitive aerobatics. The study disclosed significant exceedences of the negative limit load factor required by 14 CFR 23 for certification in the aerobatic category when obligatory groups of outside-type competitive maneuvers were performed. They also found that pilot control forces were not necessarily a reliable indication of negative normal load factors nor would the control forces be a physical limit for load factors that exceeded the minimum required negative load factors. The Safety Board recognizes that these competitive type maneuvers are not approved in all aerobatic airplanes. Nonetheless,

in view of the novice pilot's increasing exposure to aerobatics, the relative ease of inducing high negative load factors, and the demonstrated manufacturing and economic feasibility of increased structural limits (for example, the Bellanca Decathlon has limit maneuvering load factors ranging from -5 to +6), consideration should be given to expanding the design flight envelope for aerobatic certification and to the specification of stick force gradients uniquely applicable to aerobatic airplanes.

Aerobatic Accidents At Low Altitude--. The majority of stalls and spins in aerobatic related accidents occur at low altitudes--altitudes that make recovery difficult or impossible. In addition, many of the collisions with ground or water, wires, poles, and trees also reflect the hazards of performing aerobatics at low altitude. Flights conducted at these altitudes are, for the most part, contrary to and in violation of the provision contained in FAR 91.9 "Careless or reckless operations," and FAR 91.71 "Acrobatic Flight" which prohibits aerobatics at an altitude below 1,500 ft above the surface. Accident prevention efforts, therefore, should logically focus primarily on the application of more effective measures of enforcement.

Spins--. In years past, spins and spin recovery procedures have been over-simplified to some degree and only recently has it been emphasized that the recovery process required for consistent, optimum results in some airplanes may be very precise. There are, moreover, various operational circumstances stemming from confusion, apprehension, disorientation, or the misapplication of flight controls which may seriously thwart the recovery process. Because some of the knowledge regarding spin recovery techniques has only recently been attained, flight instructors are not generally aware of many of the operational implications. In an effort to disseminate the most recent spin recovery information, the FAA's Central Region devoted the entire issue of their "Flight Instructor Bulletin" of August 1975 to the subject of spins. In addition, the Central Region also initiated a series of stall spin clinics for flight instructors in order to brief them regarding the precise spin characteristics of various make and model airplanes and, through actual flight demonstrations, provide appropriate operational indoctrination. The flight instructor plays a vital role in connection with both the prevention and teaching of spins. The Safety Board believes, therefore, that these stall spin clinics should be conducted in all FAA Regions.

In a number of accidents involving spins it appeared that the relatively low altitude involved provided little or no margin for operational error such as inept or delayed recovery, misjudgment of altitude, disorientation, etc. Also, certain operational vagaries or anomalies were recently given considerable attention when several flight instructors complained of experiencing difficulties in recovering from spins. As a result of these accidents and incidents, the initiation of spins at

higher, conservative altitudes is being increasingly emphasized. Moreover, in view of the expanding interest in aerobatics, the Safety Board believes that FAR 91.71 should be amended to include a schedule of minimum initial spin altitudes; for example, no spin regardless of time, duration, or number of turns should be permitted to be initiated below an altitude of 3,500 ft above the surface and spins initiated at this altitude should not exceed a designated number of turns before recovery is begun. A conservative increment in altitude should be required for each additional spin turn or fraction thereof.

Load Factor Measurement-. Despite all the emphasis placed on the critical importance of observing an airplane's limit load factors during the performance of aerobatic maneuvers, accelerometers are not required on most aerobatic airplanes. While aerobatic pilots may acquire a general "seat of the pants" capability for sensing the approximate order of magnitude of load factors, critical dependence on this means alone to assure operation within rather precise limits does not appear justified. As previously pointed out, stick forces themselves are not necessarily a reliable indication of load factor, particularly negative load factor. Nor do stick forces pose any significant physical constraint to the generation of excessive load factors. Because accelerometers are operationally useful and fundamentally related to the performance of aerobatic maneuvers, the Safety Board believes that they should be installed in all aerobatic airplanes.

In view of the above, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Expand the presentation of flight instructor stall/spin indoctrination clinics patterned after the one initially held in FAA's Central Region on August 15-17, 1975, to include all FAA Regions and various popular make and model airplanes. (Class II--Priority Followup.) (A-76-105).

Require a commercial flight instructor to hold a "letter of competence" or its equivalent before providing aerobatic instruction other than that routinely required during the normal course of training for airman certification tests. (Class III--Longer-Term Followup.) (A-76-106).

Require that pilots obtain a logbook endorsement from an aerobatic flight instructor before performing aerobatic maneuvers other than those required in connection with airman certification tests. (Class III--Longer-Term Followup.) (A-76-107).

Issue an Advisory Circular explaining the operational considerations, airworthiness requirements, and safety aspects associated with the performance of aerobatics. (Class II--Priority Followup.) (A-76-108).

Require that all airplanes subsequently certificated in the aerobatic category, including those previously certificated in another category under a Regulatory Part other than 14 CFR 23, conform with the currently applicable structural criteria in Subpart C of FAR 23, particularly the provisions relating to limit maneuvering load factors. (Class II--Priority Followup.) (A-76-109).

Evaluate the feasibility of specifying stick force gradient requirements uniquely applicable to aerobatic airplanes in 14 CFR 23.155, "Elevator Control Force in Maneuvers." (Class III--Longer-Term Followup.) (A-76-110).

Amend 14 CFR 91.71, "Aerobatic Flight" to include a schedule of minimum initial spin altitudes. (Class II--Priority Followup.) (A-76-111).

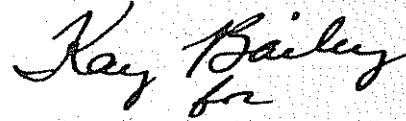
Conduct an intensive accident prevention campaign to emphasize and enforce effectively the provisions of 14 CFR 91.71, "Acrobatic flight," and 14 CFR 91.9, "Careless or Reckless Operation," (Class II--Priority Followup.) (A-76-112).

Require the installation of accelerometers in all aerobatic airplanes. (Class III--Longer-Term Followup.) (A-76-113).

Amend 14 CFR 23.337, "Limit Maneuvering Load Factor," to increase the minimum required, negative limit maneuvering load factor for aerobatic airplanes from -3.0 to -4.5. (Class III--Longer-Term Followup.) (A-76-114).

Amend 14 CFR 23.333, "Flight Envelope" to require that the negative maneuvering load factor specified in 14 CFR 23.337 for the aerobatic category remain constant between design cruising speed and design dive speed. (Class III--Longer-Term Followup.) (A-76-115).

TODD, Chairman, BAILEY, Vice Chairman, McADAMS, HOGUE, and HALEY, Members, concurred in the above recommendations.

A handwritten signature in cursive script that reads "Kay Bailey" with a small flourish underneath.

By: Webster B. Todd, Jr.  
Chairman

THESE RECOMMENDATIONS WILL BE RELEASED TO THE PUBLIC ON THE ISSUE DATE SHOWN ABOVE. NO PUBLIC DISSEMINATION OF THE CONTENTS OF THIS DOCUMENT SHOULD BE MADE PRIOR TO THAT DATE.