



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 25, 2008

In reply refer to: A-08-69 and -70

Mr. Jim Crouch
Director of Safety and Training
United States Parachute Association
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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations relate to the development of guidance, in conjunction with the Federal Aviation Administration (FAA), for improving aircraft maintenance and pilot training for parachute jump operations. These recommendations are derived from the Safety Board's special investigation of the safety of parachute jump operations¹ and are based on the evidence we found and the analysis we performed. Information supporting these recommendations is included below. The Board would appreciate a response from you within 90 days describing the actions you have taken or intend to take to implement our recommendations.

Background

The risks of parachuting are generally perceived to involve the acts of jumping from the aircraft, deploying the parachute, and landing; parachutists are aware of and manage these risks. However, in its special investigation, the Safety Board found that traveling on parachute

¹ For more information, see National Transportation Safety Board, *Special Investigation Report on the Safety of Parachute Jump Operations*, Special Investigation Report NTSB/SIR-08/01 (Washington, DC: NTSB: 2008).

operations flights can also present risks.² Since 1980, 32 accidents involving parachute operations aircraft have killed 172 people;³ most of whom were parachutists.

Although parachutists may accept risks associated with their sport, these risks should not include exposure to the types of highly preventable hazards that were identified in the Safety Board's review of the 32 accidents and that parachutists can do little or nothing to control. The Safety Board notes that passengers on parachute operations aircraft should be able to expect a reasonable level of safety that includes, at a minimum, an airworthy airplane, an adequately trained pilot, and adequate Federal oversight and surveillance to ensure the safety of the operation.

Aircraft Maintenance and Inspections

Maintenance is especially critical for parachute operations aircraft because jump operations typically involve a high ratio of cycles to flight hours and also periods of climb power followed by sudden reductions in power to descend, which can be particularly conducive to engine wear. Aircraft used in parachute operations are subject to the inspections required under 14 *Code of Federal Regulations* (CFR) 91.409; these include annual aircraft inspections, 100-hour inspections for aircraft that carry persons for hire, and additional requirements for turbopropeller-powered multiengine airplanes and certain other aircraft.

However, 14 CFR Part 91 requirements are not as extensive as the requirements for most other revenue, passenger-carrying operators, such as air carriers or on-demand Part 135 air-taxi and air-tour operators; these operators, unlike Part 91 operators, are required to incorporate their maintenance programs into an FAA-approved maintenance manual that specifies policies and procedures for ensuring that each aircraft is airworthy before it is released to service. Review of the 32 accidents showed that 8 of the accident airplanes were not airworthy at the time they were dispatched. Allowing such maintenance discrepancies not only indicates poor aircraft maintenance and inspection quality assurance practices, but also represents noncompliance with regulations.

Because they operate under Part 91, parachute operators are also not subject to the Federal regulations that require compliance with manufacturers' recommended maintenance instructions, such as service bulletins (SBs) and service information letters (SILs). Manufacturers often publish SBs or SILs that contain recommended time between overhauls (TBOs) and/or

² Safety Board accident data show that, from 1992 to 2007, about five parachutist fatalities per year resulted from accidents involving parachute operations aircraft. Direct comparisons of associated risk are difficult to calculate because multiple parachutists are likely to be carried on each flight and because there is a lack of departure data for parachute jump operations. The Safety Board notes that the FAA does not have data on the number of parachute jump operators or the number and type of aircraft used in parachute jump operations in the U.S. The absence of these data precludes any calculations of safety statistics for parachute jump operations, including accidents rates.

³ Fatal accidents excluded from this review were ground accidents in which people walked into propellers, accidents related to the inadvertent deployment of parachutes (some of which involved parachute entanglement with the aircraft), and one unauthorized parachute operation flight.

component service life limits⁴ for their engines. Some of these publications indicate that parachute operations may induce more engine wear than most other operations.⁵

In the 32 parachute operations accidents reviewed, at least 4 of the accident airplanes were powered by engines that were operated beyond their manufacturers' recommended TBOs, with which, as previously mentioned, the operators were not required to comply. Two of the airplanes (a de Havilland DHC-6-100 that crashed on July 29, 2006, in Sullivan, Missouri,⁶ and a Cessna 182A that crashed on August 14, 1993, in East Moriches, New York⁷) crashed during takeoff following a loss of engine power due to fracturing of internal components. In both cases, it is possible that, had an overhaul been performed on each engine within the respective manufacturers' recommended TBO or sooner, the conditions that led to the fractures could have been detected and corrected.

The purpose of TBO and life-limit guidance is to establish periodic inspections of the engines to ensure their serviceability. The analysis involved in developing such guidance considers the cumulative effects of various stresses placed on the engine components over time and establishes a threshold that the manufacturer has determined will provide an acceptable level of safety. Federal regulations require that commercial operators, such as air carrier, air taxi, and Part 135 air tour operators, maintain and inspect their aircraft engines in accordance with these instructions. This provides an increased level of safety by increasing the likelihood that potentially problematic conditions will be detected and corrected before more serious problems develop.

Although some manufacturers indicate in their SBs and SILs that aircraft used in parachute operations may require increased engine maintenance and inspections, no mechanism is in place to ensure that the operators of these aircraft perform any recommended maintenance and inspections. The Safety Board concludes that, because parachute jump operations are particularly conducive to engine wear, the lack of requirements for parachute jump operators to comply with manufacturer-recommended maintenance instructions for their aircraft, including SBs and SILs for TBO and component life limits, increases the potential for the persistence of

⁴ TBOs are typically based on hours, and life limits are typically based on cycles. According to an engine cycle formula published in Pratt & Whitney Canada SB 1002R24, "Turboprop Engine Rotor Components - Service Life," a full cycle consists of an engine start, one flight, and an engine shutdown. The Safety Board notes that many parachute operations pilots do not shut down the aircraft engines completely between flights. However, the SB also defines an abbreviated cycle as consisting of idle, takeoff, flight, landing, and idle, and it provides a formula to account for abbreviated cycles in an engine's accumulated total cycles.

⁵ For example, Teledyne Continental Motors Aircraft Engine SIL98-9A, "[TBO] Periods," applicable to the reciprocating engines on airplanes involved in some of the accidents reviewed, states that "aircraft used in parachute jumping ... may require more frequent engine overhauls than listed for the specific engine." Also, Pratt & Whitney SB 1803R1, "Turboprop Engine Operating [TBOs] and Hot Section Inspection Frequency," applicable to the turboprop engines on an airplane that crashed in Sullivan, Missouri, specifically excludes engines that have been used in parachute jump operations from eligibility for the manufacturer's program for extending TBOs.

⁶ For more information, see National Transportation Safety Board, *Crash of Skydive Quantum Leap, de Havilland DHC-6-100, N203E, Sullivan, Missouri, July 29, 2006*, Aircraft Accident Summary Report NTSB/AAR-08/03/SUM (Washington, DC: NTSB, 2008).

⁷ Information about the accident, NYC93FA154, is available at the Safety Board's website at <<http://ntsb.gov/ntsb/query.asp>>.

conditions that could lead to engine failure. Therefore, on September 16, 2008, the Safety Board adopted Safety Recommendation A-08-63,⁸ which asked the FAA to do the following:

Require parachute jump operators to develop and implement Federal Aviation Administration-approved aircraft maintenance and inspection programs that include, at a minimum, requirements for compliance with engine manufacturers' recommended maintenance instructions, such as service bulletins and service information letters for time between overhauls and component life limits.

The Safety Board recognizes that parachute jump operations include a wide variety of aircraft and operators, including some that operate for revenue and others that may involve some other type of business or nonbusiness arrangements. Although the Board intends that additional maintenance and inspection program requirements should be universally implemented by all operators, the Board acknowledges that the diversity of the parachute operations industry may require flexibility in determining the best mechanisms by which to implement maintenance program requirements. In addition, guidance materials could assist operators in developing effective aircraft inspection and maintenance quality assurance programs. Because the United States Parachute Association (USPA) is knowledgeable about skydiving operations and distributes safety information to its member operators through printed publications and its website (much of which is also accessible to nonmember operators and the public), the USPA can be a valuable resource with which the FAA can work to develop and distribute safety information for operators. Therefore, the Safety Board believes that the USPA should work with the FAA to develop and distribute guidance materials for parachute jump operators to assist operators in implementing effective aircraft inspection and maintenance quality assurance programs.

Pilot Proficiency and Training

A disturbing common denominator in nearly all of the 32 accidents reviewed is that the pilots, most of whom were commercial or airline transport pilots,⁹ were deficient in basic airmanship tasks, such as performing adequate preflight inspections of airplanes, complying with airplane weight and balance limitations, maintaining airspeed during powered flight, and executing emergency procedures. These deficiencies or combinations of these deficiencies were noted in nearly all the accidents. The Safety Board is concerned that the pilots, whose experience in parachute operations ranged from one flight to hundreds of flights, were unprepared to provide the parachutists with the basic level of safety that passengers should have been able to expect from professional, for-hire, or parachuting-club flight operations.

Preflight inspection of an aircraft is one mechanism by which a pilot can mitigate potential flight risks before the aircraft leaves the ground. Such inspections, according to each aircraft's preflight procedures and checklists, typically include checking the airframe for

⁸ Safety Recommendation A-08-63 is classified "Open—Await Response."

⁹ Six of the accident pilots were private pilots. Five of the accident airplanes flown by private pilots were piston-powered, single-engine Cessnas, and one was a Beech C-45H.

discrepancies, checking flight control trim settings, and ensuring adequate fuel (quantity and quality) and engine oil. Twelve of the accidents reviewed involved a loss of aircraft engine power, a challenging emergency requiring immediate and appropriate pilot responses. At least four of these engine-related emergencies could have been prevented if the pilots had adhered to basic preflight practices.

Aircraft weight and balance computations are another mechanism by which a pilot can mitigate potential flight risks before the aircraft leaves the ground. All pilots must ensure that an aircraft is loaded within its maximum allowable gross weight limitation before takeoff because excessive weight loading can adversely affect an aircraft's performance and controllability to the extent that, in some circumstances, the aircraft may be unable to obtain or sustain flight. In addition, parachute operations present unique challenges to pilots because the aircraft's load changes and shifts in flight as parachutists egress and because aircraft drag forces change as parachutists open and close aircraft doors and/or position themselves outside of the aircraft. Parachute operations pilots must consider these weight changes and perform multiple calculations before each flight to ensure that the airplane will remain within its center of gravity (cg) limits for the duration of the flight. Failure to ensure that the loading remains within the cg limits can adversely affect an airplane's stall and spin characteristics and controllability and, thus, the pilot's ability to prevent a stall or to recover the airplane from a stall or spin. In 9 of the 12 accidents involving airplanes that were loaded beyond their maximum allowable gross weights or outside their cg limits, the weight and balance issue was found to be a cause or factor.

Although several of the powered-flight accidents involved weight and balance or trim issues that could have adversely affected the pilots' ability to control the airplanes, at least three accidents, and possibly a fourth that remains under investigation, involved pilots who failed to maintain airspeed during powered flight in functional airplanes that were not reported to have been improperly loaded. These accident pilots not only failed to maintain airspeed to prevent a stall and/or spin from developing, but they also did not perform the necessary procedures to recover the airplanes from the stall/spin condition.

In addition, in the 12 accidents that involved a loss of engine power (11 shortly after takeoff and one at 3,700 feet above mean sea level), nearly all of the pilots allowed the airplanes to stall and/or made other critical procedural mistakes while responding to the engine emergencies.

Beyond possessing a current, valid airman medical certificate and a commercial pilot certificate (for revenue flights) or a private pilot certificate (for personal flights), no special qualifications are necessary for a pilot to perform parachute jump operations. Although most of the accident pilots met these qualifications, some of the pilots had little or no initial or recurrent training relating to parachute operations or in the airplanes that they were flying. Currently, there are no requirements for pilots to receive specialized parachute operations training or to demonstrate proficiency with the operations or the aircraft that they fly. The Safety Board is concerned that the accident pilots, all of whom were entrusted to fly parachutists as passengers, were deficient in performing critical, basic airmanship tasks and procedures and that these deficiencies, most of which likely could have been prevented with appropriate and effective training, contributed to the loss of numerous lives.

FAA Advisory Circular (AC) 105-2C, *Sport Parachute Jumping*, contains suggestions for improving the safety of parachute jump operations and is intended to assist operators, pilots, and parachutists with complying with the regulations that pertain to parachute jump operations. Although the AC is an established source of safety guidance, the Safety Board notes that AC 105-2C, which has not been updated since January 2, 1991, contains only basic information regarding pilot responsibilities with regard to proficiency and weight and balance calculations, and it contains little to no information regarding pilot training and examination programs, preflight inspections, emergency procedures, and parachutist egress procedures. Therefore, on September 16, 2008, the Safety Board adopted Safety Recommendation A-08-67,¹⁰ which asked the FAA to do the following:

Revise the guidance materials contained in Advisory Circular 105-2C, *Sport Parachute Jumping*, to include guidance for parachute jump operators in implementing effective initial and recurrent pilot training and examination programs that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency procedures, and parachutist egress procedures.

Because of the USPA's knowledge of parachute operations and its ability to widely disseminate safety information to both members and nonmembers, the Safety Board believes that, once AC 105-2C has been revised to include guidance for parachute jump operators in implementing effective initial and recurrent pilot training and examination programs that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency procedures, and parachutist egress procedures, the USPA should distribute this revised AC to its members and encourage adherence to its guidance.

Therefore, the National Transportation Safety Board recommends that the United States Parachute Association:

Work with the Federal Aviation Administration to develop and distribute guidance materials for parachute jump operators to assist operators in implementing effective aircraft inspection and maintenance quality assurance programs. (A-08-69)

Once Advisory Circular (AC) 105-2C, *Sport Parachute Jumping*, has been revised to include guidance for parachute jump operators in implementing effective initial and recurrent pilot training and examination programs that address, at a minimum, operation- and aircraft-specific weight and balance calculations, preflight inspections, emergency procedures, and parachutist egress procedures, distribute this revised AC to your members and encourage adherence to its guidance. (A-08-70)

The Safety Board also issued six safety recommendations to the Federal Aviation Administration.

¹⁰ Safety Recommendation A-08-67 is classified "Open—Await Response."

In response to the recommendations in this letter, please refer to Safety Recommendations A-08-69 and -70. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Acting Chairman ROSENKER and Members HERSMAN, HIGGINS, SUMWALT, and CHEALANDER concurred with these recommendations.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman