Log 2732B

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: February 3, 1999

In reply refer to: A-99-9

Mr. Tom Poberezny
President
Experimental Aircraft Association
Post Office Box 3086
Oshkosh, Wisconsin 54093-3086

On October 12, 1997, about 1728 Pacific daylight time, an experimental category, amateur-built Adrian Davis[1] Long-EZ airplane, N555JD, crashed into the Pacific Ocean near Pacific Grove, California. Air traffic control communications indicated that the airplane had departed from the Monterey Peninsula Airport's runway 28L about 1712, and the pilot performed three touch-and-go landings and departed to the west moments before the accident. Witnesses reported that they heard engine popping and a reduction in engine noise before the accident. The pilot made no distress calls. The pilot was killed, and the airplane was destroyed.

An airport maintenance technician helped the pilot push the airplane out of the hangar before the accident flight and was present during the preflight check. The technician said he told the pilot that less than a quarter tank of fuel was available in the left tank and less than half a tank of fuel was available in the right tank. The technician estimated the fuel quantity based on the assumption that the presentations on the unmarked sight gauges were linear. However, Long-EZ fuel tank sight gauges are not linear, and examination of other Long-EZ sight gauges revealed that the actual fuel on-board the airplane would have been much lower than the technician's estimate. The fuel tank sight gauges were not visible from the front cockpit. The technician loaned the pilot a shop inspection mirror so it would be possible for the pilot to see the fuel tank sight gauges in flight. The pilot told the technician that he did not wish to refuel the airplane.

The technician said he heard the engine start and run for a short time and quit. Watching from the hangar, he saw the pilot turn in the front cockpit toward the fuel selector handle behind his left shoulder. Shortly afterward, the technician heard the engine restarted. The pilot signaled an "okay" to the technician and taxied toward the runway. After the airplane departed the traffic

[1] The Federal Aviation Administration (FAA) issues experimental airworthiness certificates for amateur-built aircraft with the original builder's name as the manufacturer. Any subsequent owner may change the registration number but not the Certificate of Airworthiness. Hence, the builder's name appears on the Certificate of Airworthiness.

pattern to the west, witnesses reported that the airplane climbed to 350 to 500 feet and was in level flight when, after the reduction in engine noise, it pitched slightly nose-up, entered a steep right bank, and descended nose-first into the ocean.

Safety Board investigators determined that the weight and center of gravity of the accident airplane were within the original planned limits for the Long-EZ and would not have affected the flight or stall characteristics of the airplane. Based on the airplane's fueling history, the technician's observations of the fuel levels at engine start, and the normal fuel consumption rates of the airplane's Lycoming O-320-E3D engine, the airplane would have had about 3 1/2 gallons of fuel available from the left tank and about 6 1/2 gallons of fuel available from the right tank. The Safety Board found that witness statements were consistent with the checkout pilot's description of postflight engine shut-down[2] and concluded that the engine lost power because of fuel starvation or exhaustion.[3]

The Long-EZ was designed by Rutan Aircraft Factory and amateur-built from the Rutan plans as a single-engine, tandem cockpit, swept-wing, canard-equipped[4] airplane with laminar flow airfoils.[5] The engine is mounted aft of the cabin, and both cockpits have pitch and roll side-stick controls.

The all-composite[6] airplane has a canard with elevators for pitch control. The swept wings have taper and twist and have winglets installed at the tips. According to technicians from the Experimental Aircraft Association (EAA), the rudder system used in the Long-EZ is very sensitive[7] in low-speed flight. According to the former Rutan chief engineer, the airplane has a substantial glide ratio due to its aerodynamically clean design but will pitch up and roll right when the airspeed is slow and the right rudder is depressed. When the airspeed is higher, he stated that roll rates are much higher and that it is possible to aileron-roll the airplane from rudder application only (ailerons neutral).

According to the Long-EZ owner's manual, the airplane has good flight characteristics at minimum speed. The manual describes "stalls" as maneuvers that result in increased aft stick force or mild pitch or roll oscillations. Spin attempts result in a spiral that reportedly can be recovered by neutralizing rudder and pulling out normally. The Long-EZ design incorporates many high performance features but would not be considered "high performance" by Federal

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[2] The checkout pilot told Safety Board investigators that when the engine was stopped by closing the mixture (shutting off the fuel supply) at the end of a flight, loud popping normally occurred.

[3] For more information, see Brief of Accident #LAX98FA008 (enclosed).

[4] A canard is a lifting airfoil located in the front portion of an airplane that eliminates the need for a tail-mounted horizontal stabilizer.

[5] Laminar flow airfoils are used in high performance, complex aircraft such as the Beech Starship. The airfoil construction minimizes drag but is sensitive to boundary layer separation (stall).

[6] The Long-EZ airplane is constructed of shaped foam and fiberglass/epoxy materials.

[7] The rudder system in the Long-EZ comprises two independent, outward acting rudders on the rear of the winglets. Activation in low speed flight is very easy; however, the owners manual cautions against inadvertent use because a substantial yaw will result.

Aviation Administration (FAA) definition[8] because the airplane has no flaps or controllable pitch propeller. Nonetheless, its laminar flow airfoils have greater lift-to-drag ratios than most general aviation airplanes. Because the airplane has no flaps, its landing speeds are greater than many small airplanes, and it has a wings level, power off stall speed of about 71 mph.[9]

The Long-EZ airplane has two 26-gallon fuel tanks, one at each wing root. Fuel quantity is determined by viewing the rear cockpit sight gauges. N555JD was also equipped with a fuel totalizer.[10] Fuel is selected from the left or the right tank by turning a fuel selector handle. According to the Rutan design, the fuel selector handle is to be located just aft of the nose wheel position window between the pilot's legs and is oriented toward the right to select the right tank, left to select the left tank, and another quarter turn to the left to select the "Off" position. A placard associated with the Rutan design clearly identifies the fuel selector handle positions.

The amateur builder of N555JD modified the fuel system design by locating the fuel selector handle on the left side of the bulkhead that forms the front cockpit seat back. It was positioned approximately behind the front-seat pilot's left shoulder (see figure 1). The builder also changed the orientation of the handle so that upward selected "Off," right selected the left tank, and downward selected the right tank. The corresponding 3-position fuel selector valve was installed inside the rear cockpit on the front of the engine firewall just behind the rear seat and was connected to the selector handle via two torque tubes and a universal joint. The selector handle was about 4 feet forward of the fuel selector valve. No placard or marking existed (nor was it required) on the fuel selector handle base that would have indicated to the pilot its operating position. Further, as has been stated, the sight gauges were not marked to quantify the amount of fuel in the tanks.

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[8] The FAA defines "high performance" as an airplane that has an engine with greater than 200 horsepower or that has retractable landing gear, flaps, and a controllable pitch propeller (14 Code of Federal Regulations (CFR) Part 61.31 (e)).

[9] The maximum stall speed allowed for aircraft certificated under 14 CFR Part 23 is 61 knots (70 mph).

[10] Although the accident airplane was equipped with sight gauges, which were part of the original design, it also had a fuel totalizer installed in the front instrument panel that required pilot entry of the starting fuel amount. Witness statements provide no evidence that the totalizer was used, and the checkout pilot stated he was not familiar with it and did not provide any instruction on its use.

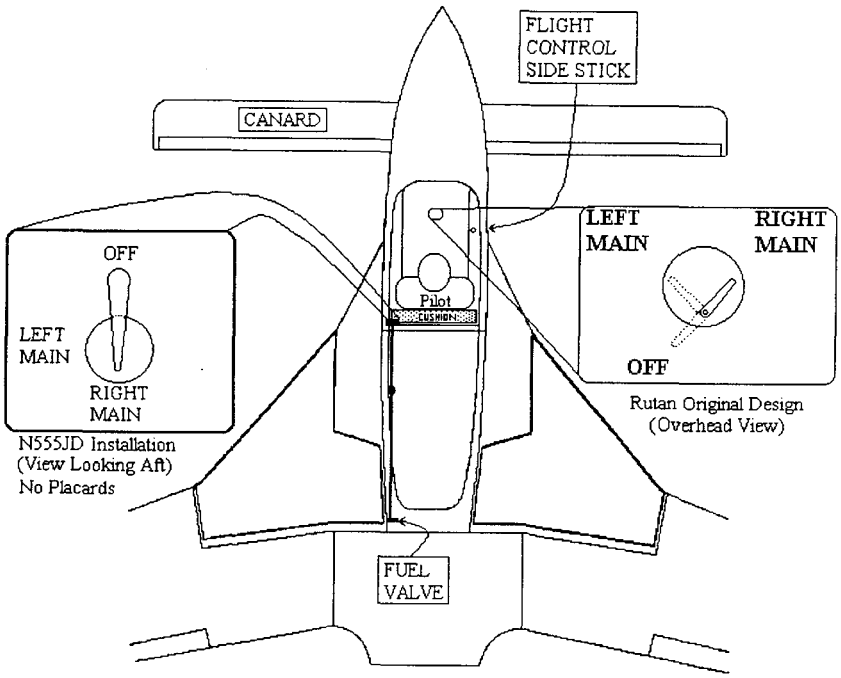

Figure 1—Comparison of fuel selector handle locations in Long-EZ

N555JD vs. Original design

The flight control side sticks in both cockpits were installed in armrests on the right side of the cockpits, measured about 6 inches high, and were similar in function to a conventional control stick. During the postaccident investigation, simulation by Safety Board staff showed that the front-seat pilot in the accident airplane would have had to loosen his shoulder harness, completely release the flight control stick, turn in his seat, and stretch to his left when reaching over the left shoulder with his right hand to change the position of the fuel selector handle on the accident Long-EZ airplane. The Safety Board investigator, in every simulation, inadvertently applied right rudder when turning his body and reaching for the fuel selector handle. This finding concerned the Safety Board because the design change that moved the fuel selector handle introduced a safety hazard in N555JD. On the basis of the accident circumstances and witness accounts, the Board concluded that the accident pilot probably inadvertently applied right rudder while manipulating the fuel selector, precipitating the loss of control that preceded the accident.

The fuel selector valve assembly from the accident airplane was found in an intermediate position; the selector valve port from the right tank fuel supply line was about 33 percent open to the engine feed line and the left was about 2 to 4 percent open to the engine feed line. An engine test run in a test cell showed that full power could be attained (with fuel in both tanks) with the selector valve in the "as found" position. However, with fuel in only one tank and the other fuel

line open to the atmosphere to simulate an empty tank, the engine lost power with the fuel selector valve in the "as found" position. The position of the fuel selector handle from the accident airplane could not be determined because of damage to the torque tubes between the valve and the selector handle.

Postaccident examination of the engine revealed no mechanical failures, and internal continuity of the drive train components was established. The magneto[11] was tested and produced a normal spark. The fuel lines had no leaks or blockages. The evidence indicated that the engine was capable of producing normal power if sufficient fuel was supplied to it.

The Safety Board determined that the probable cause of the accident was the pilot's diversion of attention from the operation of the airplane and his inadvertent application of right rudder that resulted in the loss of airplane control while attempting to manipulate the fuel selector handle. Also, the Board determined that the pilot's inadequate preflight planning and preparation, specifically his failure to refuel the airplane, was causal. The Board determined that the builder's decision to locate the unmarked fuel selector handle in a hard-to-access position, unmarked fuel quantity sight gauges, inadequate transition training by the pilot, and his lack of total experience in the type of airplane were factors in the accident.

N555JD had a special airworthiness certificate in the experimental category[12] that was issued on May 5, 1987. The airplane had been flown about 850 hours and had been sold two times since its construction. Because N555JD was an experimental, amateur-built airplane, specific deviations from the original plans did not require FAA approval nor was a placard required to identify fuel selector valve positions or to indicate that there had been a change in the airplane's design. However, the overall design is evaluated for safety and airworthiness by the FAA prior to issuing the experimental airworthiness certificate.

The Safety Board is concerned that the pilot of N555JD, who had minimal[13] pilot-in-command experience in the accident airplane, may not have been adequately familiar with the operating positions of the unmarked fuel selector handle. This is of special concern because in its modified location and orientation, the fuel selector handle's operating positions would have been less intuitively obvious than if it had been installed as originally designed. Also, demonstrations indicated that the fuel selector handle was out of the accident pilot's view and in an awkward position that a pilot of similar height as the accident pilot (5' 10") could not operate without releasing the flight control stick. An interview with the checkout pilot revealed that he

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[11] This engine had one magneto and one electronic ignition installed. The spark plugs showed evidence of normal ignition, and the magneto functioned normally when its impulse-coupling was rotated by hand. The electronic ignition was not tested.

[12] Title 14 CFR 21.191 "Experimental Certificates," allows experimental airworthiness certificates to be issued for, among other purposes, the operation of amateur-built aircraft. Amateur-built aircraft are not required to meet the standardized certification requirements contained in Part 23.

[13] Safety Board investigators determined that the accident pilot had about 70 minutes of pilot-in-command experience in this model airplane, not including the accident flight. The pilot's flight experience will be discussed later in this recommendation letter.

had avoided this problem by planning his flights in the airplane such that he never needed to operate the fuel selector valve handle in flight.

Safety Board investigators found that there are numerous experimental category airplanes that are flown without placards and markings on cockpit instruments and essential system controls, such as the fuel selector handle. Further, essential cockpit controls, including fuel selectors in amateur-built airplanes, are not required to be in standardized locations. The Board is concerned that pilots inexperienced in such airplanes may find it difficult to operate them without type-specific training (type-specific training will be discussed later in this recommendation letter).[14]

FAA Order 8130.2C, "Airworthiness Certification of Aircraft and Related Products," provides guidance to FAA aviation safety inspectors regarding the issuance of special airworthiness certificates and operating limitations for experimental aircraft. Paragraph 88(b) of this order describes inspections necessary to obtain special airworthiness certificates. It indicates that all instruments should be marked according to the approved flight manual. Advisory Circular (AC) 20-27D "Certification and Operation of Amateur-Built Aircraft," provides guidance to pilots on building, certifying, and operating amateur-built aircraft and describes the FAA's role in the certification process. Paragraph 12 of AC 20-27D states that the applicant should expect the FAA inspector or the designated airworthiness representative (DAR)[15] to verify that all required markings are properly applied. The FAA order and the AC, however, do not explicitly require the inspection of placards or markings in the cockpit before issuing special airworthiness certificates. They also do not provide adequate guidance or evaluation concerning the inspection of the placement or operation of essential controls. Because accident data from a Safety Board study suggest that the ergonomics of cockpit control placement can be critical in the safe operation of airplanes,[16] the Board is concerned that a lack of requirements for standardized placards, markings, or appropriate placement of essential system controls could jeopardize flight safety in experimental, amateur-built airplanes. Therefore, the Safety Board believes that the FAA should amend FAA Order 8130.2C to specify that, before the issuance of special airworthiness certificates, experimental, amateur-built airplanes should be inspected for needed placards and markings on cockpit instruments and for the appropriate placement and operation of

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[14] Safety Board staff found that the Glasair training syllabus directed the pilot to answer multiple questions concerning, among other subjects, fuel system descriptions, operations, and emergency procedures.

[15] DARs are private persons designated by the FAA to act in its behalf in the inspection of aircraft and to issue airworthiness certificates.

[16] A 1974 NTSB special study, U.S. General Aviation Accidents Involving Fuel Starvation (AAS-74-01) analyzed fuel starvation aircraft accidents from 1970 through 1972. Among the recommendations in the report, which were intended to reduce the number of fuel starvation accidents, the Safety Board asked the FAA to amend 14 CFR Part 23 to include specifications for standardizing fuel selector valve designs, displays, and modes of operation (A-74-39). This recommendation was classified "Closed—Acceptable Action" after the FAA changed Part 23. Currently, 14 CFR Part 23.777 addresses the physical placement of controls and states that "each fuel feed selector control must...be located and arranged so that the pilot can see and reach it without moving any seat or primary flight control when his seat is at any position in which it can be placed." The mapping of fuel selector control positions in accordance with natural expectations is addressed in 14 CFR Part 23.779, which requires that fuel selector control movement be consistent with tank selection (i.e., left for left tanks; right for right tanks).

essential system controls to ensure that they provide clear marking, easy access, and ease of operation.

The Safety Board notes that the requirement for an annual inspection (referred to as a condition inspection)[17] of experimental, amateur-built airplanes is contained in a limitations letter attached to the special certificate of airworthiness.[18] Paragraphs 141 and 142 of Order 8130.2C generally describe the issuance of experimental operating limitations,[19] which always include the inspection requirements. The operating limitations state that the condition inspection shall be recorded in the aircraft maintenance records in accordance with the scope and detail of 14 CFR Part 43, Appendix D or other FAA-approved programs and that the condition inspection is equivalent to an annual inspection.

The operations limitations may require the use of placards and markings to ensure the safe operation of the aircraft. The Safety Board is not aware of any recurrent requirement to inspect placards and markings in the cockpit and on essential system controls to ensure that they display appropriate and accurate information.

The Safety Board is concerned about the lack of requirements to periodically inspect the placards, markings, and essential controls in experimental, amateur-built aircraft. Periodic inspection of these items is necessary to ensure that they consistently display appropriate and accurate information to the pilot for flight safety. Therefore, the Safety Board believes that the FAA should amend FAA Order 8130.2C to specify that inspection limitations be issued with special airworthiness certificates for amateur-built airplanes requiring that the annual condition inspection include an inspection for needed placards and markings on cockpit instruments and the appropriate operation of essential controls to ensure that they provide clear marking, easy access, and ease of operation.

Another concern of the Safety Board was the limited amount of transition training received by the accident pilot in the accident airplane. A review of the pilot's FAA airman and medical records indicated that he held a private pilot certificate with airplane ratings for single and multiengine land, single-engine sea, instrument airplane, glider, and a Lear Jet type rating. The pilot's logbook was not recovered after the accident; however, his total flight time reported on his last physical was 2,750 hours, including 15 hours in the preceding 6 months. The Safety Board's investigation revealed that the pilot purchased the accident airplane on September 27, 1997, and that his pilot-in-command experience in the airplane was limited to a 1/2-hour ground and flight checkout on the day before the accident and a 1-hour solo flight. According to an air traffic control communication tape, the duration of the checkout flight was only 10 minutes, and the pilot departed about 20 minutes later for a 1-hour solo flight to his home airport. The Safety Board learned that the pilot had been on three previous demonstration flights in Long-EZ airplanes (during all of which he occupied the rear seat) but could not determine how much, if

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[17] Condition inspection is defined in the Airworthiness Inspector's Handbook, FAA Order 8300.10, Chapter 25.

[18] The limitations letter lists requirements for continued airworthiness.

[19] The operating limitations are designed for each aircraft. The FAA inspector may impose any operational limitations deemed necessary in the interest of safety.

any, pilot training he received during these flights.[20] The Safety Board found no evidence of the pilot having any other flight experience in Long-EZ airplanes.

On the basis of his limited flight experience in this type of airplane, the Safety Board concludes that the pilot likely did not have the necessary knowledge and skills to efficiently operate it during the emergency circumstances of the accident flight. Had the pilot been more skilled in the operation of the flight controls and knowledgeable of the unusual fuel selector, the accident might have been avoided or the severity of the accident could have been reduced.[21]

The Safety Board is aware that some advanced,[22] experimental, amateur-built airplane training organizations have published training syllabi. The Safety Board also notes that insurers[23] of amateur-built airplanes, similar to or more advanced than the Long-EZ, have sometimes required a training syllabus and detailed aircraft inspection as conditions for providing insurance coverage for the pilot/owner. The Safety Board has found that the accident rates for high performance, complex, and unusual aircraft may be substantially reduced by requiring pilot/owner-operators to undergo type-specific ground and flight training. For example, it was found that when formal flight and ground training was required for pilots of Piper PA-46 Malibu airplanes, the fatal accident rate in that airplane model was reduced.[24] Further, the Aviation Insurance Association (AIA) has reported that using and closely adhering to a specified training syllabus has considerably reduced the accident rate in the Glasair and Lancair experimental, amateur-built airplanes.[25] Additionally, the Safety Board found accident rates of Robinson R22 helicopters were substantially reduced when, in response to the Safety Board's recommendations, the FAA issued Special Federal Aviation Regulation (SFAR) 73 on February 23, 1995,

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[20] According to the Rutan engineer who gave the first demonstration flight, the pilot said he had no previous flights in Long-EZ airplanes. Only one demonstration flight was in N555JD.

[21] The in-flight manipulation of the fuel selector, the location and accuracy of the fuel quantity sight gauges, and using the installed fuel totalizer probably would have been included in formalized transition training.

[22] "Advanced" experimental airplanes are typically faster, aerodynamically cleaner, and are more complex than most amateur-built aircraft. The Safety Board staff found three companies that sell kits for experimental, amateur-built airplanes and that provide formal, type-specific ground and flight training to the owner/pilots of these airplanes. The Glasair training plan provides for approved certificated flight instructors located in different areas of the country that will conduct the formal course of instruction to the pilot. The Lancair plan provides ground instruction at its factory and provides a factory test pilot to fly at the builder's location in the builder's airplane through the first 10 hours of the flight test program. The Velocity plan has east and west coast centers that provide formal ground and flight instruction. Safety Board staff found that each company, in conjunction with insurers, mandates its specific course of training. Each of these formal programs provides certification to the insurers of the experimental, amateur-built airplane when pilots complete the prescribed training.

[23] According to the AIA, accident rates for the Glasair and Lancair airplanes have dramatically dropped because of insurers requiring pilots' use of type-specific training syllabi.

[24] A spokesman for AVEMCO (a major aircraft insurer) reported to the Safety Board that, as a condition of insurance, his company requires that all PA-46 pilots (and pilots of other pressurized airplanes) attend formal training that includes completion of a type-specific training syllabus. These programs reportedly reduced the accident rates of these airplanes. The Safety Board's accident data show no PA-46 fatal accidents during 1992 and 1997, 1 in 1993, 2 in 1998, and 3 in 1994, 1995, and 1996, respectively. None of the accidents' probable causes is attributed to inadequate transition training.

[25] The AIA has reported that by requiring type-specific transition training in conjunction with the airplane manufacturer, the accident rates for those aircraft were significantly lowered.

promulgating special training, proficiency, and operational rules for pilots operating these helicopters.[26] The SFAR required specific training in this highly responsive helicopter before a pilot could operate it as the pilot-in-command.

A 1998 query showed that the FAA's aircraft database contains about 20,244 experimental, amateur-built aircraft, including 1,200 Long-EZ airplanes.[27] According to the EAA, about 8,000 additional aircraft were in the process of being built by amateur builders in 1997, and in the next few years, a significant number of amateur-built airplanes will be sold to non-builders. As previously mentioned, experimental, amateur-built aircraft are not required to be certificated to 14 CFR Part 23 certification standards and, therefore, may well have control locations, functions, and markings that do not conform to the original design plans. Because of these and other differences (such as performance and handling characteristics) between experimental, amateur-built aircraft and Part 23 aircraft, quality transition training[28] of pilots flying them is critical to their safe operation.

The Safety Board is aware of the EAA's Flight Advisor Program, which is designed to help amateur airplane builders safely perform their first flight. In this program, advisors with substantial flying/building experience offer free advice, videos, and written guidance to help make builders' first test flight a safe one. The advisors do not provide flight training but offer training suggestions and options for the pilot to consider. This program, which the EAA claims has resulted in reduced first-flight accident rates,[29] is generally known among EAA members but not among the general pilot population.

Such programs can provide an added margin of safety for pilots inexperienced in the operation of unusual or unique, non-Part 23-certificated aircraft. Unfortunately, no FAA ACs, pamphlets, or programs exist that require or encourage pilots who did not build their experimental category airplanes to receive type-specific transition flight training. FAA publications and programs also lack emphasis on the benefits of formalized syllabi for such transition training. The Safety Board concludes that an expanded flight advisor program could substantially reduce the experimental, amateur-built airplane accident rate. Therefore, the Safety Board believes that the EAA should establish, in conjunction with the FAA and the AIA, a cooperative program that strongly encourages pilots transitioning to unusual or unfamiliar amateur-built, experimental category airplanes to undergo formalized, type-specific transition training similar to that provided to pilots of some advanced, experimental, amateur-built airplanes.

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[26] For more information, see NTSB Special Investigation Report, NTSB/SIR-96/03, Robinson Helicopter Company R22 Loss of Main Rotor Control Accidents, dated April 2, 1996.

[27] According to the EAA, 4,500 Long-EZ plans were sold. The EAA estimates that about 95,000 plans or kits have been sold to prospective amateur builders of all aircraft types in the past 10 years.

[28] The Safety Board considers quality transition training to be type-specific, formal transition training that adheres to a training syllabus.

[29] The EAA has reported significant accident rate reductions since the Flight Advisor program was started in 1995.

Therefore, the National Transportation Safety Board recommends that the Experimental Aircraft Association:

> Establish, in conjunction with the Federal Aviation Administration and the Aviation Insurance Association, a cooperative program that strongly encourages pilots transitioning to unusual or unfamiliar amateur-built, experimental category airplanes to undergo formalized, type-specific transition training similar to that provided to pilots of some advanced, experimental, amateur-built airplanes. (A-99-9)

Also as a result of its investigation, the Safety Board issued Safety Recommendations A-99-5 through -7 to the FAA and A-99-8 to the AIA.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation A-99-9 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred with this recommendation.

By: Jim Hall
Chairman

Enclosure

National Transpo[illegible]on Safety Board
Washington, [illegible].C. 20594

Brief of Accident

Adopted 01/26/99

LAX98FA008
FILE NO. 1406 10/12/97 PACIFIC GROVE, CA AIRCRAFT REG NO. N555JD TIME (LOCAL)- 17:28 PDT

MAKE/MODEL -ADRIAN DAVIS-LONG-EZ
ENGINE MAKE/MODEL -Lycoming O-320-E3D
AIRCRAFT DAMAGE -Destroyed
NUMBER OF ENGINES -1
OPERATING CERTIFICATES -NONE
TYPE OF FLIGHT OPERATION -Personal
REGULATION FLIGHT CONDUCTED UNDER -14 CFR 91
HOMEBUILT

	FATAL	SERIOUS	MINOR/NONE
CREW	1	0	0
PASS	0	0	0

LAST DEPARTURE POINT - MONTEREY, CA
DESTINATION - Local

AIRPORT PROXIMITY - Off airport/airstrip
AIRPORT NAME - MONTEREY PENINSULA
RUNWAY IDENTIFICATION - 28L
RUNWAY LENGTH/WIDTH (Feet) - 7598/150
RUNWAY SURFACE - Asphalt
RUNWAY SURFACE CONDITION - Dry

CONDITION OF LIGHT - Daylight

WEATHER INFO SOURCE- Weather observation facility

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - None
VISIBILITY - 50.000 SM
WIND DIR/SPEED - 300 /005 KTS
TEMPERATURE (F) - 63
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 53

CERTIFICATES/RATINGS
Private
Single-engine land, Multiengine land, Single-engine sea
Glider
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT - 2750
LAST 90 DAYS - Unk/Nr
TOTAL MAKE/MODEL - 2
TOTAL INSTRUMENT TIME - Unk/Nr

The pilot had recently purchased the experimental, amateur-built Long-EZ airplane, which had a fuel system that differed from the designer's plans. The original builder had modified the fuel system by relocating the fuel selector handle from a position between the front pilot's legs to a position behind & above his (or her) left shoulder. There were no markings for the operating positions of the fuel selector handle, which were up (for off), down (for the right tank), and to the right (for the left tank). This deviation from the original design plans did not require FAA approval, nor did it require a placard to indicate such change from the original design. On 10/11/97 at Santa Maria, CA, the pilot received a 1/2-hour flight and ground checkout in the airplane by another Long-EZ pilot. The checkout pilot reported that the pilot needed a seatback cushion to be in position to reach the rudder pedals, and that he had difficulty reaching the fuel selector handle while seated with the cushion added. The pilot then departed on a 1-hour

flight to his home base at Monterey with an estimated 12.5 gallons of fuel in the right tank & 6.5 gallons in the left tank. The checkout pilot estimated about 9 gallons of fuel were needed for the flight, and he noted the fuel selector was positioned to the right tank before departure. On 10/12/97 (the next day), a maintenance technician assisted the pilot in preparing for another flight. During preflight, the pilot was not observed to visually check the fuel. The technician noted that when the pilot was seated in the airplane, he had difficulty reaching the fuel selector handle. Also, he gave the pilot a mirror to look over his shoulder to see the unmarked, non-linear, fuel sight gauges, which were located in the rear cockpit. The technician estimated the available fuel and advised the pilot that the left tank indicated less than 1/4 full and that the right tank indicated less than 1/2 full. He said his estimate was based on the assumption that the gauges were accurate and linear. The pilot declined an offer for additional fuel, saying he would only be airborne about 1 hour and did not need fuel. The technician observed that before the engine was started, the fuel selector handle was in a vertical position; however, he did not note whether it was up (off) or down (right tank). As the technician went to the hangar, he heard the engine start & run for a short time, then quit. He saw the pilot turn in the seat toward the fuel selector handle, then the pilot motioned with his hand that things were all right. The technician did not observe whether the pilot had repositioned the fuel selector. The pilot restarted the engine, taxied, took off, and performed three touch-and-go landings in a span of about 26 minutes, followed by a straight-out departure to the west. Ground witnesses saw the airplane in straight and level flight about 350 to 500 feet over a residential area, then they heard a reduction of engine noise. The airplane was seen to pitch slightly nose up; then it banked sharply to the right & descended nose first into the ocean. The major structural components of the airframe were found fragmented on the ocean floor near the engine, but no preimpact part failure was found. The fuel selector valve was found in an intermediate position, about 1/3 open between the engine feed line and the right tank, and about 2-4% open to the left tank. Tests using another engine showed that the engine could be operated at full power with the selector in the as-found position; however, when the cap was removed from the left port (simulating the effect of an empty left tank), fuel pressure dropped to less than 1/2; & within a few seconds, the engine lost power. Conditions were simulated using another Long-EZ to evaluate the maneuver required to switch tanks from the front seat. The simulation revealed that 4 actions were required to change the fuel selector in flight: 1) Remove pilot's hand from the control stick; 2) Loosen shoulder harness; 3) Rotate upper body to the extreme left to reach the fuel selector handle; & 4) Rotate the handle to a non-marked (not logically oriented) position. During the evaluation, investigators noted a natural reaction for the pilot's right foot to depress the right rudder pedal when turning in the seat to reach the fuel selector handle. With the right rudder depressed in flight, the airplane would pitch up slightly & bank to the right.

LAX98FA008
FILE NO.1406 10/12/97 PACIFIC GROVE, CA AIRCRAFT REG NO. N555JD TIME (LOCAL)- 17:28 PDT

Occurrence# 1 LOSS OF ENGINE POWER(TOTAL) - NONMECHANICAL
Phase of operation CRUISE

Findings
1. FUEL SYSTEM,SELECTOR/VALVE
2. ACFT/EQUIP,INADEQUATE CONTROL LOCATION - OWNER/BUILDER
3. FUEL SYSTEM,SELECTOR/VALVE - UNMARKED
4. ENGINE INSTRUMENTS,FUEL QUANTITY GAGE - INADEQUATE
5. ENGINE INSTRUMENTS,FUEL QUANTITY GAGE - UNMARKED
6. PREFLIGHT PLANNING/PREPARATION - INADEQUATE - PILOT IN COMMAND
7. REFUELING - NOT PERFORMED - PILOT IN COMMAND
8. FUEL TANK SELECTOR POSITION - IMPROPER - PILOT IN COMMAND
9. FLUID,FUEL - STARVATION/EXHAUSTION

Occurrence# 2 LOSS OF CONTROL - IN FLIGHT
Phase of operation EMERGENCY DESCENT/LANDING

Findings
10. REMEDIAL ACTION - ATTEMPTED
11. RUDDER - INADVERTENT ACTIVATION - PILOT IN COMMAND
12. DIVERTED ATTENTION - PILOT IN COMMAND
13. INADEQUATE TRANSITION/UPGRADE TRAINING
14. LACK OF TOTAL EXPERIENCE IN TYPE OF AIRCRAFT - PILOT IN COMMAND

Occurrence# 3 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of operation DESCENT - UNCONTROLLED

Findings
15. TERRAIN CONDITION - WATER

The National Transportation Safety Board determines the probable cause(s) of this accident was: the pilot's diversion of attention from the operation of the airplane and his inadvertent application of right rudder that resulted in the loss of airplane control while attempting to manipulate the fuel selector handle. Also, the Board determined that the pilot's inadequate preflight planning and preparation, specifically his failure to refuel the airplane, was causal. The Board determined that the builder's decision to locate the unmarked fuel selector handle in a hard-to-access position, unmarked fuel quantity sight gauges, inadequate transition training by the pilot, and his lack of total experience in this type of airplane were factors in the accident.