

Board Meeting : Adrian Davis Long-EZ, N555JD, Pacific Grove, California, October 12, 1997

1/26/1999 12:00 AM

### **History of Flight**

On October 12, 1997, shortly after 1728 Pacific daylight time, an experimental Adrian Davis Long EZ, N555JD, crashed into the Pacific Ocean near Pacific Grove, California. The airplane was destroyed and the pilot, the sole occupant, received fatal injuries. The accident occurred during a local, personal flight, visual meteorological conditions and no flight plan was filed.

An aircraft maintenance technician who assisted the pilot in removing the airplane from a hangar before the accident flight stated that he observed the pilot perform a preflight check that took about 20 minutes. He stated that the pilot borrowed a fuel sump cup and drained a fuel sample to check for contaminants. He did not observe whether the pilot visually verified the quantity of fuel aboard the airplane. He did not see the pilot check the engine oil level.

The technician stated that he and the pilot talked about the inaccessibility of the cockpit fuel selector valve handle and its resistance to being turned. The handle was located behind the pilot's left shoulder. They attempted to extend the reach of the handle, using a pair of vice grip pliers. But this did not solve the problem as the pilot could not reach the handle. The pilot said he would use the autopilot inflight, if necessary, to hold the airplane level while he turned the fuel selector valve.

According to the maintenance technician, the pilot declined an offer of fuel service. The pilot told him that he would only be flying for about 1 hour. The pilot then got in the airplane and proceeded with his preflight duties, including checking the operation of the control surfaces. According to the technician, he observed the fuel selector handle in a vertical position. (see Aircraft Information section for a discussion of fuel selector handle ). The technician said that he went into the hangar to put away his tools, and he heard the engine start; however, it soon quit. He walked out of the hangar and observed the pilot turned in his seat to the left, toward the fuel selector location. The technician said he believes that the pilot changed the fuel selector and restarted the engine.

A review of the Monterey Peninsula Airport Air Traffic Control Tower (ATCT) tapes revealed that the pilot contacted ground control at 1702 and obtained a taxi-for-takeoff clearance from the hangar. At 1709, the pilot contacted the local controller, reported ready for takeoff on runway 28, and requested to stay in the traffic pattern for some touch-and-go landings. He was subsequently cleared for takeoff at 1712, and performed three touch-and-go landings before departing the traffic pattern about 1727. At this time the controller asked the pilot to recycle his transponder code, and the pilot did so. The ATC tapes revealed no recorded distress calls from the pilot, and the pilot did not indicate any aircraft or engine malfunctions.

A certified audio cassette re-recording of the transmissions between the accident airplane and the Monterey ATCT local control position was sent to the Safety Board's audio laboratory for analysis. The radio transmissions were examined on an audio spectrum analyzer in an attempt to identify any background sound signatures that could be associated with either the engine or the propeller. Analysis of nine transmissions between 1714 and 1728:06 showed engine speed

harmonics between 2,100 and 2,200 revolutions per minute (rpm). At the last radio transmission attributed by the Federal Aviation Administration (FAA) to the accident aircraft (at 1728:06), the measured frequency was to 2,200 rpm. A copy of the laboratory report is attached.

Twenty witnesses to the accident were interviewed. Some of the witnesses observed the airplane descend into the ocean near Point Pinos approximately 150 yards off shore, where the water is 30 feet deep. Depending on where they were when the crash occurred; four of the witnesses indicated that the airplane was originally heading west; five of them observed the airplane in a steep bank, with four of those five reporting the bank was to the right (north). Twelve witnesses saw the airplane in a steep nose-down descent, and 6 of them saw the airplane hit the water.

Witnesses estimated the airplane at 350 to 500 feet over the residential area while heading toward the shoreline. Eight of the witnesses said that they heard a "pop" or "backfire," along with a reduction in the engine noise level just before the airplane descended into the water.

### **Pilot Information**

The pilot's logbook was not recovered. During the investigation, the pilot's FAA airman and medical records were obtained from the Airman and Medical Records Certification Branch, FAA, in Oklahoma City, Oklahoma. On his most recent medical application of record, dated June 13, 1996, he reported a total flight time of 2,750 hours. He held a private pilot certificate, with airplane ratings for single and multiengine land, single-engine sea and gliders. He also held an instrument airplane rating and a Lear Jet type rating.

Another Long EZ pilot (hereinafter referred to as the "checkout" pilot), gave the pilot about 1/2 hour of ground and flight checkout in the accident airplane in Santa Maria, California on the

day before the accident, before the pilot's departure for Monterey. He said that they performed two touch-and-go landings and some slow flight maneuvers, and that they discussed the aircraft systems, including the fuel selector location. He said that he had made arrangements with the pilot to relocate the fuel selector handle while the pilot, a musical performer, was away on tour. He also said that a pillow was placed on the back of the pilot's seat to assist him in reaching the rudder pedals.

The checkout pilot stated that about a month before the accident, he had flown in the front seat with the pilot on a demonstration flight in the accident airplane. He said the pilot had also flown in the backseat on two other Long EZ demonstration flights.

A certified true copy of the pilot's FAA medical record files were obtained and reviewed by Safety Board investigators. According to the pilot's FAA medical records, the physician who examined the pilot on June 13, 1996, issued a third-class medical certificate to the pilot at the conclusion of the examination. His FAA medical records further showed that on November 6, 1996, the FAA Civil Aeromedical Certification Division sent the pilot a letter by certified mail, return receipt requested, acknowledging receipt of his June 13, 1996, medical application and stating, in part:

We had previously received an interim report from H. C. Whitcomb, Jr., M.D., pertinent to your alcohol problem. Dr. Whitcomb reported that "in general averages two to four drinks of either wine or beer/week when he's traveling." He further stated that there has been no abuse, (see footnote 1) ...in our letter of October 18, 1995, we specified that your "continued airman medical certification remains contingent upon your total abstinence for use of alcohol."

The letter informs the pilot that based on the above information, he did not meet the medical standards prescribed in Part 67 of the Federal Aviation Regulations, and a determination was made that he was not qualified for any class of medical certificate at that time. The letter further states: "If you do not wish to voluntarily return your certificate, your file may be sent to our regional office for appropriate action." According to U. S. Postal Service markings on the envelope, the letter was returned unclaimed to the FAA on December 2, 1996.

Examination of the FAA medical file disclosed that following the return of the unclaimed November 6, 1996, letter there was no followup action by the FAA until March 25, 1997, when the agency sent the pilot a second letter by certified mail, return request requested, again notifying him that he was medically disqualified. The return receipt for the certified letter was examined by Safety Board investigators; however, the signature of the person who had signed for the mail was illegible.

### **Aircraft Information**

The accident airplane was an experimental amateur built canard (1) type aircraft. The data plate indicated a manufacture date of June 1987. The airplane was designed by Rutan Aircraft Factory and was built from the Rutan plans by Adrian D. Davis, Jr. Review of FAA Aircraft Registry records for the airplane revealed that the original builder applied for an airworthiness certificate in the amateur-built, experimental category on May 5, 1987. The airworthiness certificate was issued by an FAA Airworthiness Inspector from the Houston, Texas, Flight Standards District Office on June 12, 1987. On the application, the inspector checked the box stating "I have found the aircraft described meets the requirements for the certificate requested."

A letter of operating limitations was also issued on that date and included the statement: "This aircraft shall contain the placards, listings and instrument markings required by FAR 91.3 (Subsequently redesignated 14 CFR 91.9).

The airplane was equipped with an electric force bias trim system for both the pitch and roll axis, and an electrically actuated speed brake that deploys from the fuselage belly. The switches for the electric trim and the speed brake were located on the side stick controller. The airplane was equipped with a single axis roll autopilot, but the autopilot was not recovered.

According to the checkout pilot, and confirmed by the seller, the canard had the Ronz No. 1145ms airfoil.

According to the operator's manual, the Long EZ was designed either for a rear mounted Continental O-200 (100 horsepower (hp)) or a Lycoming O-235 (115 hp) engine. The engine installed on the accident airplane was a Lycoming O-320-E3D, producing 150 hp and consumes 8.5 to 10 gallons of fuel per hour depending on the power setting. This engine installation also required the installation of 50 pounds of ballast in the nose. An electrical starter was also installed on the engine.

The airplane's designer provided a written statement to the Safety Board in response to an inquiry regarding the compatibility of the airframe with the Lycoming O-320 engine. He stated that "the only engines approved by the factory for installation" are the Continental models O-200 or O-240, or the Lycoming O-235. The designer reported that he is aware that some Long EZ's have been modified with engines of up to 200 horsepower and operate at weights 50 percent above the prototype limit, and that "this level of experience with growth versions does

indicate that there are substantial margins in the design. According to the pilot who sold the airplane to the accident pilot and the checkout pilot, disclosed that no ballast was installed in the nose. However, two batteries, totaling 40.8 pounds, were relocated in the nose section, one directly in front of the foremost bulkhead and the other just behind it.

FAA records indicate that the seller who sold the airplane to the accident pilot purchased the airplane from the builder on March 5, 1994. On April 13, 1996, the seller changed the registration number from N5LE to N228VS. According to the seller, the airplane was sold to the accident pilot on September 27, 1997. The airplane was then (by the checkout pilot) flown from Santa Ynez to Santa Maria, California, to be repainted in connection with the sale to the pilot. During the repainting of the aircraft, the registration number of was changed by the pilot to N555JD.

At Santa Maria, the airplane was sanded, primed, and painted. Telephone interviews with personnel at the paint shop revealed that the old paint was not stripped off. No control surfaces were removed at any time. The only items removed during the painting were the two wing-mounted cargo pods, which were painted in a multicolored scheme and reinstalled. As applied, the paint weighed about 4 pounds per 100 square foot, according to paint shop personnel.

During the investigation, copies of a empty airplane weight and balance document, dated May 18, 1996, were located at Craftsmans Corner, Santa Paula, California. It listed an airplane empty weight of 1,061 pounds and center of gravity (CG) at 110.0 inches. In an interview, the manager of Scaled Composites, Inc., (Rutan Aircraft) estimated that, based on the total wetted area of the

airplane, the paint applied at Santa Maria would have added 30 pounds to the empty weight for a total of 1,091 pounds with a CG at 110.0 inches.

Based the weight and balance document and estimates of the airplane's probable fuel load at the accident flight's departure from Monterey, gross weight and CG conditions were calculated and are appended to this report. Those calculations show that at the beginning of the accident flight, the airplane would have had a gross weight of approximately 1,310 pounds, with a CG at 103.65 inches. At the time of the accident, the airplane would have had a gross weight of approximately 1,280 pounds, with a CG at 103.63 inches. According to Scaled Composites Inc., the design gross weight limit is 1,425 pounds and the CG range is from the forward limit of 98 inches to the rear limit of 103 inches.

In a telephone interview on June 15, 1998, an engineering representative from Scaled Composites, Inc., reported that the airplane was designed with a published aft limit of 104 inches, and the prototype was extensively tested and flown at this limit. Subsequently, in the interests of conservative margins, the designer changed the published limit to 103 inches. According to the designer during flight tests, the prototype was flown at 106 inches and flew all test points satisfactorily, and no adverse handling characteristics were noted.

The representative from Scaled Composites, Inc., also reported that the company flew the same profile as that believed to have been flown during the accident flight (start, taxi, run-up, takeoff, three touch-and-goes, and a pattern departure) in a Lycoming O-320-equipped Long-EZ and measured the fuel consumed at 3.6 gallons. After running one tank dry, a time interval of 6 to 8 seconds was measured between changing the fuel selector and the resuming of engine power.

The representative stated that although the fuel tanks of the airplane were extensively damaged, during the wreckage reconstruction he observed that the fuel tanks were built to plan specifications. The representative of Scaled Composites, Inc. said the system does not appear to have an unusable quantity. Two sumps, each having about a quart capacity, are located in the tanks. The tank is designed so that the fuel will feed into the sumps in all flight attitudes. The representative said the only known condition that would tend to favor an unporting is in a prolonged descent with just a few gallons of fuel in the tank.

According to the designer of the airplane and the drawings issued to the builder, the fuel selector is to be located just aft of the nose wheel position window between the pilot's legs. The accident airplane's fuel selector handle was positioned by the builder on the bulkhead behind the pilot's left shoulder. The selector valve was installed inside the engine firewall 45 inches aft of the selector handle. The handle and valve were joined by steel and aluminum tubing, connected by a universal joint.

According to the designer and the seller, this type of airplane has two 26-gallon fuel tanks in the wing roots that contain usable fuel. The fuel quantity is determined by viewing non-linear sight gauge gauges located in the rear cockpit at the wing roots. The sight gauges show an amount of actual fuel supporting a red float. Postaccident examination of the airplane disclosed that the sight gauges were not marked or calibrated for quantity.

The maintenance technician who helped the pilot move the airplane out of the hangar before the accident flight mentioned that the fuel sight gauges were only visible to the rear cockpit occupant. The pilot then asked the technician about the quantity of fuel shown. The technician

told the pilot that he had "less than half in the right tank and less than a quarter in the left tank." The technician said that he estimated the fuel quantity based on the assumption that the gauge presentation was linear. The technician provided a shop inspection mirror to the pilot so that he could look over his shoulder at the fuel sight gauges. The mirror was recovered in the wreckage.

According to other pilots who were familiar with the airplane and/or had flown it, to change the fuel selector a pilot had to: 1) Remove his hand from the right side control stick if he was hand flying the aircraft; 2) Release the shoulder harness; 3) Turn his upper body 90 degrees to the left to reach the handle; and 4) Turn the handle to another position. Two pilots shared their experiences of having inadvertently run a fuel tank dry with nearly catastrophic consequences because of the selector and sight gauge locations.

The fuel selector handle location was discussed with the seller and other pilots who had flown the accident airplane. The seller reported that he had asked the builder why he had located it behind the pilot's left shoulder. The builder responded that he did not want fuel in the cockpit area. The seller said that when he changed tanks inflight he would engage the autopilot, allowing his right hand to reach behind his left shoulder to the selector handle. The seller said that at the time of the accident, the handle was "firm to turn with good detents." He also said that the checkout pilot had removed the selector valve for cleaning and lubricating some time ago. The checkout pilot said that the seller attempted to work on the valve in early 1996, but that he (the checkout pilot) ended up finishing the repair in April 1996. He also said that he had removed the two rivets that were drilled through the brass valve shaft and the he had replaced one of the two torque tubes.

The checkout pilot was asked about the selector. He said that he had simulated changing tanks using the selector on one occasion on the ground and that he was not pleased with the location. Because of the difficulties of using the selector, he said that he had never used the selector in flight.

Postaccident wreckage examination by Safety Board investigators revealed that the selector handle was not placarded or marked for any operating position. According to the checkout pilot, the handle in the right position was for the left tank, the handle in the down position was for the right tank, and the off position was up.

When investigators attempted to switch fuel tanks in a similar Long EZ, each time while an investigator turned his body the 90 degrees required to reach the valve, his natural tendency was to extend his right foot against the right rudder pedal to support his body as he turned in the seat.

Concerning the yaw flight controls, the representative from Scaled Composite, Inc. reported that the rudders move and serve as vertical spoilers. Pressing on the right rudder peddle moves only the right rudder in an outboard direction, which produces increased drag and a subsequent yawing moment. He stated that the rudders are very effective because of the long moment arm. With a center of effort (increased drag) above the longitudinal CG, activation of a rudder will produce a pitch-up moment along with the yaw. The airplane also has a very strong spiral mode. He also reported that the lateral roll control with the side stick controller is very sensitive and that a 1/8 inch movement will cause a roll initiation.

The airplane's logbooks were not recovered. According to the seller of the airplane, the airframe and engine had accumulated about 850 total flight hours. He reported that the last FAA-required, 12-month condition inspection had taken place on September 20, 1997.

The checkout pilot who flew the airplane from Santa Ynez to Santa Maria for repainting estimated that before his departure 5 gallons of fuel was on board with 2 gallons on one side and 3 gallons in the other. He stated that he added 10 gallons of fuel to each tank. The checkout pilot said that he did not update the Fuelwatch (2) fuel monitoring instrument after refueling because he was not familiar with the procedure. The flight to Santa Maria lasted 10 minutes it is estimated to have consumed 2 gallons of fuel. During the pilot's 30-minute checkout at Santa Maria, the checkout pilot estimated that 4 gallons of fuel were consumed.

The checkout pilot stated that the pilot flew the airplane from Santa Maria to Monterey, and that he had departed with about 19 gallons of fuel onboard. There were 12.5 gallons of fuel in the right tank and 6.5 gallons in the left tank. He noted that the selector was located on the right tank before to the pilot's departure from Santa Maria.

The Safety Board and the parties to the investigation estimated that the amount of fuel required to fly to Monterey from Santa Maria ranged from 6.4 to 9.1 gallons, depending on the power settings used. Estimates for fuel used during the checkout flight at Santa Maria ranged from 2.5 to 3.6 gallons. The accident flight was estimated to have consumed 3.0 to 4.3 gallons, for a combined total consumption of 11.9 to 17.0 gallons of fuel. Fuel records disclosed that the airplane was not refueled at Monterey Airport.

## **Wreckage and Impact Information**

The wreckage was located the Pacific Ocean in 30-foot water within about 150 yards of the rocky shoreline near Pacific Grove, California. An underwater video taken by a diver from the National Oceanic and Atmospheric Administration, Monterey Bay National Marine Sanctuary, revealed broken rock structures where the airplane wreckage was located on the ocean floor.

The broken sections of rock were free of normal underwater growth.

The recovery was made by members of the Pacific Grove Ocean Rescue Team and members of the Sheriff's Dive Team. All major structural components of the airframe were found in a fragmented state on the ocean floor near the engine. Most of the control system rods and rod ends were recovered. The landing gear assembly was separated from the fuselage, and the right wheel and brake were separated from the gear leg. The nose gear was found in the retracted position.

The engine was found separated from the airframe structure but remained attached to its mounts. The mounts were crushed in a forward direction. Two induction tubes were found broken from the engine. The wooden composite-covered propeller hub was still attached to the engine crankshaft flange. Both propeller blades were severed about 18 inches outboard of the hub center. Fragmented composite propeller blade coverings and blade wood were recovered near the engine. Subsequent layout disclosed that the fragments comprised the leading edges of both blades.

The engine was examined externally and internally. Gear and valve train continuity was established by rotation. Cylinder compression was established. All cylinders were removed and

examined. The accessory housing was removed for examination of the oil pump gears and crankshaft gear. The carburetor was removed and opened for a visual examination. Fuel and water were found in the carburetor bowl. The magnetos had been replaced with an electronic ignition system. There were no discrepancies found during these examinations.

During the investigation, the wreckage was laid out with the recovered components placed in their normal positions. All aircraft extremities were accounted for in the examination. All recovered control system push-pull tubes and associated bell cranks were examined, with overload signatures evident and no unusual operating condition noted. No battering or over-travel signatures were observed to any control limit stop.

### **Medical and Pathological Information**

On October 13, 1997, the Monterey County Medical Examiner performed an autopsy on the pilot. According to the report, the cause of death was multiple blunt force trauma. During the examination, samples were obtained for toxicological analysis by the FAA's Civil Aeromedical Institute in Oklahoma City, Oklahoma. Tests were negative for all screened drugs and Ethanol.

### **Tests and Research Information**

The fuel selector, linkage, universal joint, handle, and handle bearing block were recovered. The brass selector stem/shaft was found fractured between two opposing drilled rivet holes that attach the hollow portion of the shaft to the torque tube/handle linkage. The Safety Board's Materials Laboratory examined the stem/shaft fracture. Although the stem/shaft was severely

weakened by the rivet addition, there was no evidence of pre-impact failure on the stem. A copy of the laboratory report is attached.

The brass 3-port Imperial fuel selector valve assembly was examined and found in an intermediate position, which was one-half open between the engine feed line and the right tank fuel supply line. The port to the left tank was also observed to be open about 2 to 4 percent to the engine feed line. The valve was found frozen in place and could not be moved. The fuel valve was plumbed into an engine test cell, with the fuel supply connected to the valve's right tank fuel port. At that point, the left tank port was open to the atmosphere and was subsequently capped. An exemplar Lycoming O-320 engine was installed in the test cell, started and run to maximum power. The one-half-open right port position had negligible effect on the engine power output; however, when the cap was removed from the left port (simulating the effect of an empty left tank) the fuel pressure dropped to less than one-half, and within a few seconds the engine quit because of the fuel/air mixture resulted in a vapor state.

The steel and aluminum rods connecting the handle to the fuel selector valve were found bent. The rods were straightened to determine the handle position relative to the valve position. Extensive metallurgical and installation examinations were performed at the Safety Board Materials Laboratory and with exemplar aircraft in the field. Copies of the laboratory reports are attached.

The Safety Board examined the recovered wreckage for evidence of a possible bird strike. There were no leading edge canard or wing sections intact. The canopy was destroyed, and only fragments of the Plexiglas were recovered. Bird feathers were found commingled in the

recovered wreckage. The curator of the local Museum of Natural History was asked to view the feathers during the wreckage examination. A seat cushion determined to be from the accident airplane was found torn open. According to the cushion material tag, it was filled with goose feathers; however, the curator also found duck feathers in the cushion. The cushion feathers matched the ones found commingled with the wreckage.

### **Additional Information**

The wreckage was released to the insurance adjuster representing the pilot on June 10, 1998.

When it was last viewed by investigators the wreckage was located at Monterey, California.

1. A type of airplane in which the pitch controls that are normally mounted on the empennage of the airplane are mounted ahead of the main lifting plane. An airplane on which the pitch controls are mounted forward of the wing rather than behind the wing.
2. A fuel management system that provides a fuel burn rate and fuel remaining.

### **Footnote 1:**

1. The letter from Dr. Whitcomn dated March 22, 1996, was also in the pilot's medical file it stated: "In general, he has done remarkably well. For the last three weeks, he has been on a fast and has had absolutely no alcohol, but in general averages two to four drinks of either wine or beer/week when he's traveling. There has been no abuse. The patient seems very happy and balanced at this stage of his life."