



National Transportation Safety Board Aviation Accident Final Report

Location:	Merritt Island, FL	Accident Number:	ERA14FA282
Date & Time:	06/09/2014, 2036 EDT	Registration:	N516XL
Aircraft:	LIBERTY AEROSPACE INCORPORATED XL-2	Aircraft Damage:	Destroyed
Defining Event:	Loss of control in flight	Injuries:	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

According to a friend of the airplane's owner, the purpose of the flight was for the owner to check out another pilot in the airplane. It could not be determined which pilot was flying the airplane at the time of the accident. Review of uncorrelated radar data indicated that the flight departed and maneuvered in the local area for about 26 minutes before the accident occurred. One witness stated that the airplane was about 200 ft above ground level when it entered a turn, and then its nose dropped and it descended to the ground. Two other witnesses reported seeing the airplane descending in a nose-down attitude. The witnesses provided conflicting information as to whether or not the airplane's engine was producing power. Examination of the accident site indicated that the airplane impacted in a steep descent. The witness observations and the impact geometry are consistent with the pilots failing to maintain adequate airspeed while maneuvering, resulting in the airplane exceeding its critical angle of attack and experiencing an aerodynamic stall.

The propeller blade signatures were consistent with the engine not producing power at impact. Engine parameter data downloaded from the full authority digital engine control's (FADEC) data recording device revealed normal rpm, cylinder head temperature, and fuel pressure readings from takeoff to the end of the recorded data, and no FADEC fault codes were recorded. However, the recorded data ended before the loss of control occurred. Postaccident examination of the engine powertrain, fuel distribution block, and fuel injectors revealed no evidence of preimpact failure or malfunction. Both of the engine's electronic control units sustained impact damage that precluded operational testing. Although the auxiliary fuel pump was determined to have been inoperative for a long period of time before the flight due to separation of one electrical wire near the pump, the engine-driven fuel pump was operational and capable of providing adequate fuel to the engine to sustain engine power. The investigation could not determine the reason the engine was not producing power at impact.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the pilots to maintain airspeed while maneuvering, which resulted in the airplane exceeding its critical angle of attack and experiencing an aerodynamic stall. Contributing to the accident was the loss of engine power for a reason that could not be determined by the postaccident examination, which was limited due to impact damage.

Findings

Aircraft	Airspeed - Not attained/maintained (Cause) Angle of attack - Capability exceeded (Cause)
Personnel issues	Aircraft control - Pilot (Cause)

Factual Information

HISTORY OF FLIGHT

On June 9, 2014, about 2036 eastern daylight time, a Liberty Aerospace, Incorporated XL-2, N516XL, crashed in a residential area approximately 1.5 nautical miles north-northwest of Merritt Island Airport (COI), Merritt Island, Florida. Both occupants were fatally injured and the airplane was destroyed. The airplane was registered to Spatial, Inc., and operated under the provisions of 14 Code of Federal Regulations (CFR) Part 91 as a personal flight. Visual meteorological conditions prevailed at the time and no flight plan was filed for the local flight that originated from COI.

The purpose of the flight was a checkout of an individual by the airplane owner seated in the right seat. The owner's girlfriend provided a timeline indicating the last text message she received from him was at 1808, indicating he was on his way to the checkride. About 2 minutes later, or at 1810, the left seat occupant left a voice mail message indicating that he was at the end of his driveway waiting for the right seat occupant to drive past. At 1930, a friend reported seeing the airplane on a taxiway at COI with the doors open and no-one nearby. The girlfriend further reported that she had a commitment with her boyfriend at 2000 hours that day.

One witness reported to the Federal Aviation Administration (FAA) inspector-in-charge seeing the airplane flying about 200 feet above ground level, then bank to the east. He observed the nose drop and the airplane went straight down. He reported the engine popped then became quiet and popped again. The witnesses estimated he was approximately 1/2 mile from the accident site. The same witness provided a sworn taped interview to the Brevard County Sheriff's Office Agent indicating hearing the engine rev up while descending followed by hearing the sound of the crash.

Another witness reported to the FAA-IIC observing the airplane flying about 300-400 feet above the ground with the aircraft spinning nose down. He then lost sight of the airplane.

Still another witness reported to the FAA-IIC hearing a swooshing sound and realized it was an aircraft. He noted that the engine was not running and the airplane was a couple hundred feet in the air as he saw it go straight down like from 12 to 6 o'clock. He called 911 to report the accident. The same witness also provided a sworn taped interview to the agent of Brevard County Sheriff's Office indicating that he did not hear the engine running during flight.

The homeowner reported to NTSB that on the date and time of the accident, he was inside his house in his kitchen. He reported it was still light out, and he heard a loud sound that shook his house. He reported prior to the impact he did not hear an engine sound. It took him about 1 minute to find his phone, and he called 911 at 2036. He went outside and spotted the wreckage. While near the wreckage there was no sound from it and no "obvious smell of fuel." He estimated that law enforcement was on-scene within 2 minutes and fire rescue responded shortly thereafter. He was the only person present in his home at the time.

FAA personnel reported there was no record of any ATC contact, no flight plan, and no contact with LM Automated Flight Service Station.

Radar data from Orlando Approach Control, that utilizes Space Coast Regional Radar Sensor was examined by NTSB for uncorrelated and primary radar returns using the accident site location (latitude and longitude) and accident time as a starting point and working backwards.

That review revealed at 2010:14, an uncorrelated radar target at 200 feet mean sea level (msl) was located about 0.4 nautical mile and 95 degrees from the departure end of runway 11 at COI. The target remained in left traffic pattern for COI, then departed flying north of the airport where changes in direction occurred. While remaining north of the airport between 2035:05 and 2035:19, the flight proceeded in a northwesterly direction while flying between 1,400 and 1,300 feet msl. At 2035:24, a primary radar return with no altitude available was located nearly due west and about 270 feet of the previous radar target. The next uncorrelated radar target at 2035:29, at 500 feet msl was located about 417 feet and 348 degrees from the primary radar return. Excluding the primary radar return, between 2035:19 and 2035:29, the airplane descended 800 feet, resulting in a calculated average rate of descent of about 4,800 feet per minute. The accident site was located about 130 feet and 142 degrees from the last uncorrelated radar return. Plots of the uncorrelated radar targets and raw radar data utilized for the plots are contained in the NTSB public docket.

PERSONNEL INFORMATION

The left seat occupant, age 65, held a private pilot certificate with airplane single and multi-engine land ratings issued August 29, 2013, and held a third class medical certificate with a limitation, "must have available glasses for near vision" issued on July 2, 2012. On the application for his last medical certificate he listed a total time of 30 hours. There were no records of enforcement action. His wife reported he was in "very good health" and did not take any medication, and just had a physical 6 months earlier.

The right seat occupant, age 47, held an airline transport pilot certificate with multi-engine land rating issued April 3, 2014. He also held a commercial pilot certificate with airplane single and multi-engine land, instrument airplane ratings, issued January 30, 2013. He held a first class medical certificate with limitation to wear corrective lenses issued on December 2, 2013. On the application for his last medical certificate he listed a total time of 2,140 hours. There were no records of enforcement. His son indicated he was in excellent health, and his girlfriend indicated he was not taking any prescription medication, but would take Ibuprofen as needed for a sore back.

A review of the right seat occupant's pilot logbook that was found in a bag in the wreckage revealed it contained entries between June 20, 2010, and April 6, 2014. He logged time in the following aircraft: Cessna 150, Cessna 172, Piper PA-28R, Piper PA-23-250, Fairchild SA-227, Casa 212, and the accident airplane. Between these dates he logged a total time of approximately 863 hours, of which approximately 41 were as pilot-in-command in the accident airplane. His first logged flight in the accident airplane occurred on January 11, 2013, and his last logged flight in the accident airplane occurred on April 6, 2014.

Correlation of the right seat occupant's flight time in the accident airplane after his last logged flight was performed using the "Aircraft Flight Log." Between his last logged flight and June 2, 2014, he accrued 3.2 hours in the accident airplane, resulting in a total of 43.7 hours make and model.

AIRCRAFT INFORMATION

The airplane was manufactured in 2006 by Liberty Aerospace, Inc., as model XL-2, and was designated serial number 0011. It was powered by a 125 horsepower Continental Motors, Inc., IOF-240-B engine controlled by Full Authority Digital Electronic Control (FADEC) system which includes two Electronic Control Units (ECUs), Health Status Annunciator (HSA),

FADEC Sensor Set, and low voltage wiring harness. The airplane was also equipped with a Sensenich W69EK7-63G fixed pitch wood/fiberglass propeller.

Following manufacturing, on June 26, 2007, Service Instruction Letter (SIL) 06-006 was complied with which installed an Aerosance engine data interface (EDI) model EDI-200. On July 16, 2007, the EDI-200 was removed and a new EDI was installed.

A review of the "Aircraft" logbook that contained entries from January 19, 2006, to the last entry dated September 15, 2013, revealed no entry related to removal or repair of the auxiliary fuel pump. The airplane was last inspected in accordance with an annual inspection on September 15, 2013; the airplane total time at that time was recorded to be 615.6 hours. There were no further entries in the airframe or engine logbooks after the annual inspection was signed off as being completed. Further review of the aircraft maintenance records revealed an entry dated May 23, 2008, indicating the aircraft total time was 570.8 hours, while an entry dated January 7, 2013, indicates the total time was 568.9 hours, consistent with record keeping errors and the airplane not being operated for over 4 years 7 months. According to the FAA Registration Application dated January 11, 2013, the right seat occupant listed himself as the president under the name, "Spatial, Inc." The next entry in the airframe maintenance after the right seat occupant purchased the airplane was dated August 2, 2013, which indicates the airplane total time was 613.4 hours. Excerpts of the Airframe and Engine logbooks are contained in the NTSB public docket.

A spiral bound "Aircraft Flight Log" book which documents flights, flight date, time out, time in, flight duration, fuel information, and discrepancies was found in the wreckage. The book documented flights between February 2, 2013, and June 2, 2014. Further review of it revealed that after the annual inspection was signed off, an entry dated December 19, 2013, indicates, "Fadec caution [intermittent] rough engine." Another entry the same day indicates, "intermittent 20 [degrees] flap", likely referring to the flap position indicator light. An entry dated December 20-21, 2013, indicates, "Fadec panel flickered for about 5 [minutes]", while an entry on December 23, 2013, indicates, "20 degrees flap [indicator] intermittent." An entry dated January 17, 2014, indicates, "Fadec caution flash." There were no entries related to the FADEC between January 19, 2014, and the last entry dated June 2, 2014. Further review of the entry for June 2, 2014, indicates no discrepancies, 14 gallons of fuel were added, and the ending time was 667.0 hours. Excerpts from the "Aircraft Flight Log" are contained in the NTSB public docket.

Service Instruction Letter (SIL) RKI-SIL-08-001 had not been complied with; therefore, the gross weight was 1,653 pounds.

METEOROLOGICAL INFORMATION

The terminal area forecast (TAF) for COF issued on June 9, 2014, at 1800 UTC, valid until June 10, 2014, until 2400 UTC, indicates the wind was forecast to be from 100 degrees at 12 knots, the visibility was forecast to be greater than 6 miles, and scattered clouds at 3,000 and 10,000 feet were forecast. Temporarily between 1900 UTC to 2300 UTC, broken clouds were forecast at 3,000 feet, overcast clouds at 5,000 feet, and from 2300 UTC to 2400 UTC, the wind was forecast to be from 140 degrees at 9 knots, the visibility was greater than 6 knots, few clouds at 3,000 feet and scattered clouds at 5,000 feet. From 0500 UTC on June 10, 2014 to 0600 UTC, the wind was forecast to be from 210 degrees at 6 knots, the visibility greater than 6 miles, few clouds at 3,000 feet.

A surface observation weather report taken at Patrick Air Force Base (COF), Cocoa, Florida, at 2058, or approximately 22 minutes after the accident indicates the wind was from 120 degrees at 6 knots, the visibility was 10 statute miles, and clear skies existed. The temperature and dew point 27 and 24 degrees Celsius respectively, and the altimeter setting was 29.97 inches of Mercury. The accident site was located about 9 nautical miles and 334 degrees from COF.

According to the U.S. Naval Observatory, sunset occurred at 2019, and the end of civil twilight occurred at 2046. Excerpts of Weather Reports and Records are contained in the NTSB public docket.

AIRPORT INFORMATION

The Merritt Island Airport is a publically owned uncontrolled field with a published common traffic advisory frequency (CTAF)/UNICOM of 122.975. The frequency is not recorded.

A fixed base operator (FBO) at COI has a VHF transceiver; however, they closed at 1900 hours that day, and the CTAF/UNICOM frequency is not recorded.

FLIGHT RECORDERS

The airplane was equipped with an Engine Data Interface (EDI), TCM P/N 657230 Rev A, P/N 14049 B, S/N 0643005. The EDI was retained by NTSB for read-out by the NTSB Vehicle Recorder Division, located in Washington, D.C.

According to the NTSB Vehicle Recorder Division Report concerning the EDI, the file structure on the card was found to be corrupted due to the rapid removal of electrical power as a result of the accident. The file structure was rebuilt using data recovery software and the recorded data was extracted normally. The last file recorded identified as "edio036.dal" contained what appeared to be three flights. The 1st flight recorded from takeoff to landing was approximately 3426 seconds, or 57.2 minutes long. The 2nd flight in the file was about 2126 seconds, or 35.4 minutes long and the 3rd flight was approximately 98 seconds long. Without having the date and time accurately recorded in the data files no positive determination could be made as to what flight segment was the accident flight.

There were no engine or engine controller faults recorded during the last recorded data file (edio036.dal) which included the accident flight.

Correlation of the engine data from elapsed time to the event local time, EDT, was performed with an offset to the time of the accident. The recorded data in approximately 1 second increments associated with the last file revealed engine start occurred about 2017:04, and the data continues without interruption until 2036:00, resulting in approximately 19 minutes of recorded data.

The report also indicates correlation of data associated with engine start, taxi, and run-up. For about 1 minute 3 seconds after takeoff, or to the end of the recorded data, the rpm was noted to be between approximately 2,500 and 2,600, the fuel pressure increased from 39 psi to about 56 psi (within normal green arc range), and all readings for cylinder head temperature were above the minimum reported values. A copy of the report and downloaded data as an attachment are contained in the NTSB public docket.

WRECKAGE AND IMPACT INFORMATION

The airplane crashed in the side yard of a residence located in a high density residential area; the wreckage was located at 28 degrees 22.083 minutes North Latitude and 080 degrees

41.252 minutes West longitude, or on the east side of a residence. The airplane was upright and all parts necessary to sustain flight remained connected or were in close proximity to the main wreckage.

Further inspection of the accident site revealed the airplane came to rest upright on a magnetic heading of 266 degrees, with the empennage resting against an approximate 6 foot tall fence that was oriented on a north/south direction. Power-lines located about 20 feet above ground level and above the fence were not damaged, and there was minimal damage to the western edge of the house located approximately 13 feet west of the fence. Furniture located in the side yard sustained impact damage. The tip of one propeller blade was noted extending from the impact crater associated with the engine and propeller; the impact crater was about 12 inches deep. The nose landing gear was structurally separated.

Inspection of the wreckage revealed no evidence of fire on any observed component; the fuel tank was breached on the bottom portion. First responder personnel cut the aft spar attach of the left wing during the recovery efforts. According to the Federal Aviation Administration (FAA) inspector-in-charge, there was very little fuel smell when he arrived on scene a few hours after the accident. As part of the recovery, the insurance company contracted with a company to take soil samples for determining the extent of fuel leakage. Preliminary results found several "hot spots" which correlated with the area beneath the ruptured fuel tank. Testing revealed fuel was detected 5 feet below the surface, which correlated with the water table level.

The wreckage was recovered to a secure location for further inspection. Inspection of the airframe following recovery revealed the empennage was separated, but both wings remained attached to the fuselage. All primary and secondary flight control surfaces remained attached. The flap drive cross tube was separated from the airplane; reportedly removed by rescue personnel. The flap rod end fitting remained attached to the flap drive, which was broken at the top, but remained attached to the fuselage. The actuator was extended 31/32 inch as measured from the end of the rod to the housing which equates to flaps retracted position; the roll pin was present.

Inspection of the right side of the rudder revealed an impact mark consistent with that being made by the right stabilator inboard edge. Positioning of the two control surfaces matching the impact on the right side of the rudder correlated to the rudder trailing edge right and the right anti-servo tab trailing edge down. A gouge on the left side of the rudder was also consistent with contact by the inboard side of the left stabilator. The rudder push/pull tube was fractured at the aft pushrod attachment. The left and right stabilators were interconnected, and the forward fin spar was not attached to the underside of the fuselage. The pitch trim actuator was inspected and found to be extended 11/16 inch as measured from the end of the housing to the bottom of the washer, or 1 5/8 inches from the housing to the center of the rod end, which equates to trim tab trailing edge up; the roll pin was present. No separations were noted of the trim drive system attach points. Inspection of the trim drive control mechanism revealed continuity from the drive to the control surface.

Inspection of the left wing revealed the aft spar was cut, and the main spar upper and lower pins were in the "home" position. The flap and aileron flight control surfaces remained attached at all hinges, and the aileron balance weights were attached. The stall strip remained attached on the leading edge, and the stall warning vane remained attached but exhibited impact damage. The stall warning vane remained electrically connected and full movement of the vane could not be performed due to the impact damage; however, slight movement of the

vane resulted in changes in the resistance readings taken at the wire attach terminals on the stall warning vane. The pitot mast remained installed but dirt was inside the hole in the leading edge while the drain hole appeared clear. The leading edge was crushed aft along its span.

Inspection of the right wing revealed the aft pin was in the "home" position or engaged, and the forward upper and lower pins were also in the "home" or engaged positions. The flap and aileron flight control surfaces remained attached at all hinges, and the aileron balance weights were attached. The stall strip remained attached on the leading edge. The leading edge of the wing was rotated up varying degrees along the wingspan, from about 80 degrees at the wing root to 60 degrees at the wingtip. The leading edge of the right wing exhibited an impact about 34 inches wide beginning about 12 inches inboard from the end rib. The impact was consistent with damage to a patio table that exhibited rivet spacing gouges about 0.75 inch on center. The rivet spacing was consistent with the leading edge.

Inspection of the aileron flight control system revealed that control continuity was confirmed for the left wing from the control surface to the wing root where the pushrod exhibited bending overload. The left aileron pushrod remained connected to the aileron quick connect fitting, and the bellcrank was fractured below the torque tube which was displaced aft approximately 8 inches. No separations were noted at any of the aileron flight control system attach points. Control continuity was also confirmed for the right wing from the control surface through to the aileron quick connect to the center line. No separations were noted at any of the aileron flight control system attach points.

Inspection of the rudder flight control system revealed the rudder aft pushrod was bent and fractured at the rod end near the control surface and bent but remained connected at the aft bellcrank. The intermediate pushrod was bent and fractured at the aft and center bellcranks. The forward pushrod was bent and fractured at the center and forward bellcranks, and the rudder input pushrod remained connected at both ends. The attach for the rudder forward bellcrank was bent and fractured near the attach, and also near the forward rudder pushrod attach. The rudder pedals remained attached to the torque tube. No separations were noted at any of the rudder flight control system attach points.

Inspection of the stabilator flight control system revealed the aft pushrod was fractured in 2 pieces. The rod end near the rear bellcrank was bent and fractured, and the rod end at the mid fuselage pitch control idler plate was also bent and fractured. The forward pitch control pushrod rod end was bent at fractured at the mid fuselage pitch control idler plate, and was bent and fractured at the yoke assembly. No separations were noted at any of the stabilator flight control system attach points.

Inspection of the cockpit revealed it was extensively damaged and fragmented. A plastic covered checklist with several pages was found in the wreckage positioned to the "Engine Runup" page which contained 35 items. The bottom of the page was dated October 2006. The key remained in the ignition switch which was in the both position; the key was bent to the right. The FADEC Power A switch was in the off position and was bent down and to the left. A bronze color material was noted on the handle of the switch consistent with contact by the adjacent ignition switch key. The left side of the tooth was under the left detent. The FADEC Power B switch was also in the off position but there was no apparent damage. The left and right seat shoulder harness restraints were cut, as were both seat inboard and outboard restraints. One four-point restraint was identified and was observed to be latched; no determination was made as to what seat the observed restraint was from. The fuel boost pump

switch was in the "Auto" position. Further information concerning the cockpit instruments can be found in the Excerpts of NTSB Field Notes which are contained in the NTSB public docket.

Inspection of the electrical system revealed the aircraft's main battery positive and negative cables were cut during the recovery process. The main battery voltage tested 12.68 volts, while the FADEC standby battery tested 12.56 volts. The two-part "split" master switch was separated from the instrument panel but remained electrically connected. By tracing of the wire numbers, the battery switch was in the up, or on position and the alternator switch was in the down, or off position.

Inspection of the aircraft's fuel system revealed the fuel tank was breached. The outlet line remained connected to the fitting of the tank and also at the inlet fitting at the fuel strainer, but the tank was impact damaged in the area of the fitting. No obstructions were noted of the fuel supply from the tank to the fuel strainer, which was drained and found to contain about 1 ounce of blue fuel consistent with 100 low lead; no water was detected when testing using water finding paste. The strainer bowl and filter were removed and some shavings were noted in the bowl and on the filter element. The fuel supply lines from the fuel tank to the fuel strainer, to the auxiliary fuel pump, to the fuel selector, and forward to the firewall fitting were inspected and with the exception of areas that were crushed associated with impact, no obstructions were noted. The auxiliary fuel pump which remained secured to the structure and electrically connected was attempted to be powered using a portable power supply connected at the pump's electrical connection. Because no fuel was available, water was placed in the inlet hose to prevent the pump from operating dry. During that attempt, a sound was thought to be heard briefly, but the water was not pumped from the outlet fitting. The auxiliary fuel pump was removed, drained of material from the inlet hose, and retained for further inspection at the manufacturer's facility. The fuel selector knob was separated from the fuel selector, which was removed to verify its position. The fuel selector valve was free of obstructions and wide open, consistent with it being on. The check valve associated with the fuel return was inspected and found to be installed in the proper orientation.

The engine which remained partially attached to the airframe through cables, wires, fuel lines and one engine mount was removed for further inspection, which revealed it sustained damage consistent with impact damage concentrated to the forward right portion of the engine. Both electronic control units (ECU's) remained attached to the engine firewall and were impact damaged. The connector for ECU1 had broken free from the rest of the ECU, while the connector for ECU2 remained attached to the ECU; both were retained for further inspection. Crankshaft, camshaft, and valve train continuity was confirmed to all cylinders. Suction and compression was noted in cylinder Nos. 1, 2, and 4, and weak suction was noted at the No. 3 cylinder during crankshaft rotation due to the No. 3 cylinder intake rocker arm that separated from the cylinder due to impact damage. Borescope inspection of the cylinders revealed normal operating signatures for all cylinders. The internal engine timing was correct and the crankshaft was slightly bent. The starter had broken free from the engine; all of the other accessories remained attached to the engine. Inspection of the lubricating system components of the engine revealed no evidence of preimpact failure or malfunction. The low voltage wiring harness was torn and severed in several areas.

Inspection of the engine-driven fuel pump revealed it remained secured to the engine and a small amount of fuel was noted in the outlet line; no fuel was noted in any other fuel lines. The engine-driven fuel pump drive shaft was intact and with hand rotation, a small amount of

residual fuel was noted coming from the outlet. The engine-driven fuel pump was retained for bench testing. Inspection of the fuel distribution block revealed it remained secured to its attach point and sustained minor impact damage; one of the electrical connectors had broken free from the distribution block. Disassembly inspection of the distribution block revealed normal operating signatures; no contaminants were noted in the fuel screen. A small amount of residual fuel was noted within the distribution block; no fuel recovered from any of the fuel lines for the distribution block. All fuel injector nozzles remained installed in their respective cylinders and were undamaged. The fuel injectors were removed and no obvious damage was noted to the nozzles or coils. All fuel injector nozzles and associated coils were retained for further inspection. Inspection of the bypass fuel filter assembly revealed it remained secured to its attach point and was undamaged. Disassembly inspection of the fuel filter assembly revealed no contaminants were noted within the fuel screen. No fuel was recovered from the bypass filter assembly or the attached fuel lines.

Inspection of the air induction and exhaust system components revealed impact damage to varying degrees, but there was no evidence of preimpact failure or malfunction. Inspection of the Speed Sensor Assembly revealed it sustained a significant amount of damage consistent with impact. The signal conditioner portion of the sensor assembly was destroyed, while the position sensor array remained installed in its respective installation point and was undamaged. The position sensor array was retained for further examination.

Inspection of the throttle body revealed it remained attached to its respective installation point and was undamaged. The throttle arm was secure; the throttle cable rod end was removed and it was noted that the throttle valve was capable of moving through its entire travel. The throttle position micro-switch remained attached to the throttle body and was undamaged. The throttle was moved to the full throttle positions and it was noted that the micro-switch arm contacted the throttle cam; however, the micro-switch did not activate. The throttle body was retained for further examination.

The two bladed, fixed-pitch propeller which remained attached to the propeller flange exhibited one blade that was full span, and the other blade was fractured at the hub. The fractured blade was broken apart into several pieces, and exhibited chordwise scratches on the cambered side of the blade, while the full span blade was cracked and displayed minor chordwise scratches near the hub.

MEDICAL AND PATHOLOGICAL INFORMATION

Postmortem examinations of both occupants were performed by Dr. Podkaski, of the District Eighteen Medical Examiner's Office, Rockledge, Florida. The cause of death for both was listed as, "multiple blunt force injuries."

Forensic toxicology was performed on specimens from both occupants by the FAA Bioaeronautical Sciences Research Laboratory (FAA CAMI), Oklahoma City, Oklahoma. Forensic toxicology was also performed on specimens from both occupants by Wuesthoff Reference Laboratory (Wuesthoff).

The report for the left seat occupant by FAA CAMI indicated the results were negative for carbon monoxide, volatiles, and tested drugs; testing for cyanide was not performed. The report by Wuesthoff indicates the results were negative for volatiles and the blood immunoassay screen, while caffeine and caffeine metabolite were detected in the chest fluid.

The report for the right seat occupant by FAA CAMI indicated the results were negative for

carbon monoxide, volatiles, and tested drugs; testing for cyanide was not performed. The report by Wuesthoff indicates the results were negative for volatiles and the blood immunoassay screen, while caffeine and caffeine metabolite were detected in the chest fluid.

TESTS AND RESEARCH

Correlation of the permanent maintenance records with the hand written entries made in an "Aircraft Flight Log" pertaining to the FADEC entries indicates there was no maintenance record entries regarding any troubleshooting that was performed. It was also noted there were several entries in the "Aircraft Flight Log" which indicate there were no FADEC annunciators. Excerpts from the airframe and engine permanent maintenance records as well as the "Aircraft Flight Log" are contained in the NTSB public docket.

Examination of the auxiliary fuel pump was performed at the manufacturer's facility with FAA oversight which revealed the electrical wires and non-Weldon supplied connector were protected by heat-shrink tubing. No damage to the connector, heat shrink, or wiring was noted. The pump was then electrically connected but the device exhibited results consistent with an open electrical circuit (it did not draw current when energized). Continuity testing between the positive and negative terminal of the electrical connection of the pump-motor revealed an infinite resistance consistent with an open electrical circuit. Hand movement of the wires with the meter connected did not result in any resistance reading. Both electrical wires of the pump-motor were then cut along their length, and power was applied to the pump/motor but a dead short electrical circuit/locked rotor condition was noted. The motor was unbolted from the pump assembly, and there was "alarmingly little evidence of normal operational wear in the motor to drive interface", and there was no evidence of the drive cavity having been exposed to anything out of the ordinary. Electrical power was then applied to only the motor assembly via the cut wires and the unit was found to operate normally. The pump was then attempted to be rotated using a hand tool and was unable. Disassembly inspection of the pump revealed internal contamination consistent with long-term inactivity of the pump. As part of the inspection the shrink wrap was carefully cut parallel to the wires to expose the lead wires. As the shrink wrap was moved away, the negative (black colored wire) fell freely away. cursory inspection of the negative lead wire revealed no evidence of any heat damage consistent with the high current degrading the termination. Following the inspection of the pump, it was subsequently returned to the storage facility, and then sent to the NTSB Materials Laboratory for examination. A report from the manufacturer and concurring statement from the FAA inspector are contained in the NTSB public docket.

According to the NTSB Materials Laboratory Factual Report concerning the inspection of the broken conductor strands of the black wire of the auxiliary fuel pump, the ends of wire strands were still visible inside the connector. The insulation around the wire had evidence of material flow, and ridges were observed on one side of the wire. The side of the wire diametrically opposite the ridges was thinned due to the material flow. Smearing covered portions of the fracture surfaces on the strands, and the fracture surfaces on a few strands were completely obscured by damage. The undamaged areas of the strand fracture surfaces had ductile dimples consistent with overstress separations resulting from tension; the ductile dimples were elongated in one direction on several fracture surfaces consistent with overstress in shear. No melting was noted on any of the strand ends. The terminals for the black (negative) and orange (positive) colored wires were removed from the connector for further examination using a Liberty Aerospace technical document for reference. The terminal for the black wire was

determined to have the crimp too far forward and an oversize bellmouth, while the terminal for the orange also had an oversize bellmouth and a Banana crimp, or bending of the terminal. Additionally a pinched strand was observed in the terminal for the orange colored wire. The NTSB Materials Laboratory Factual Report is contained in the NTSB public docket.

Examination and bench testing of the engine-driven fuel pump was performed at the manufacturer's facility with NTSB oversight. The testing was performed to the standards for a new production fuel pump, and did not take into account adjustments for the airframes fuel system. Following inspection which documented the damage, the pump was placed on a test bench and a small leak (approximately 2 drops every 3 seconds) was noted originating near the diaphragm. Less than specified discharge fuel pressure was noted at Test Points, 3, 4, and 5. The fuel discharge pressure at Test Point 4 which equates to full RPM of the pump was 7.33 psi less than the minimum specified; however, according to personnel of the engine manufacturer, the out of tolerance condition is adjustable and likely would have no effect. A copy of the inspection and bench test results are contained in the NTSB public docket.

Correlation of the "Engine Runup" plastic covered checklist that was found in the wreckage with the version from the FAA Approved Airplane Flight Manual (FAA Approved AFM) revealed omitted items, incorrect sequences, abbreviations, and incorrect information. For example, item 5 of the checklist found in the wreckage indicates the "Fuel Boost Pump Mode Switch" be turned "ON", while the FAA Approved AFM indicates for step 6 that the "Fuel Boost Pump Mode Switch" be turned off. Both checklists then indicate to verify that the "HSA Fuel PMP Annunciator" to "CHECK ON." A search of the internet produced an exact copy of the "Engine Runup" checklist that was found in the wreckage. Copies of the impact damaged checklist found in the wreckage, the identical "Engine Runup" checklist that was found on the internet, and the "Engine Run-up" checklist from the FAA Approved Airplane Flight Manual are contained in the NTSB public docket.

Review of the "Starting Engine" checklist of the FAA Approved AFM revealed a step to listen for operation of the boost pump after turning it on position.

Following the results of the NTSB Material Laboratory inspection of the terminals of the auxiliary fuel pump, the airframe manufacturer representative was asked to inspect the terminals of auxiliary fuel pumps in stock for similar conditions. According to the manufacturer representative, those inspections determined that some additional crimps were found that do not meet the required specification of the technical document; those pumps are being corrected. The airframe manufacturer subsequently developed Service Bulletin (SB) 15-001 to inspect the terminals of auxiliary fuel pumps in service for evidence of improper terminal installation. The SB was published on August 19, 2015, and is contained in the NTSB public docket.

Components consisting of both ECU's, speed sensor, fuel distribution block, fuel nozzles and coils, and throttle body were examined and/or tested at the manufacturer's facility with FAA oversight. While impact damage to both ECU's and speed sensor precluded operational testing, visual examination of them revealed no anomalies. The fuel distribution block was disassembled and no anomalies were noted with the internal components; no contaminants were noted at the fuel filter. Operational testing of the fuel nozzles and coils revealed all operated normally with no anomalies noted. Examination of the throttle body revealed the switch operated normally during throttle movement; no anomalies were noted. Although the engine-driven fuel pump was previously operationally tested with NTSB oversight, it was tested

again. The results are listed in the manufacturer's report along with the FAA concurring statement which is contained in the NTSB public docket.

Based on the separated condition of the black wire at the terminal of the auxiliary fuel pump which rendered it inoperative, the airplane manufacturer representative was asked to perform testing on an exemplar airplane to determine what annunciators would be present in the cockpit and whether the engine could be started without the auxiliary fuel pump. According to the manufacturer representative, it was possible to start a cold or hot engine without the auxiliary fuel pump, but during starting of a cold engine it took "4 labored starts." After engine start the engine ran normally. The representative pointed out that the FAA Approved AFM indicates as part of the starting engine checklist to listen to the sound of the operation of the auxiliary fuel pump. With respect to annunciators comparing an operative vs. inoperative pump, the testing determined that the annunciators from the Health Status Annunciator (HSA) are the same, although with an inoperative pump no audible sound would be heard with the fuel pump switch in the on or auto positions when commanded by the FADEC at approximately 1,200 rpm and below.

History of Flight

Maneuvering	Loss of engine power (total)
Maneuvering-low-alt flying	Aerodynamic stall/spin Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Airline Transport; Commercial	Age:	47
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 1 With Waivers/Limitations	Last FAA Medical Exam:	12/02/2013
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	04/03/2014
Flight Time:	2140 hours (Total, all aircraft), 43.7 hours (Total, this make and model), 18.3 hours (Last 90 days, all aircraft), 3.2 hours (Last 30 days, all aircraft)		

Other Flight Crew Information

Certificate:	Private	Age:	65
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	None	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 3 With Waivers/Limitations	Last FAA Medical Exam:	07/02/2012
Occupational Pilot:	No	Last Flight Review or Equivalent:	08/29/2013
Flight Time:	30 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	LIBERTY AEROSPACE INCORPORATED	Registration:	N516XL
Model/Series:	XL-2	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	0011
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	09/15/2013, Annual	Certified Max Gross Wt.:	1653 lbs
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	616 Hours as of last inspection	Engine Manufacturer:	CONT MOTOR
ELT:	C91A installed	Engine Model/Series:	IOF-240-B
Registered Owner:	SPATIAL, INC.	Rated Power:	128 hp
Operator:	SPATIAL, INC.	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Dusk
Observation Facility, Elevation:	COF, 8 ft msl	Distance from Accident Site:	9 Nautical Miles
Observation Time:	2058 EDT	Direction from Accident Site:	154°
Lowest Cloud Condition:	Clear	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	6 knots /	Turbulence Type Forecast/Actual:	/ Unknown
Wind Direction:	120°	Turbulence Severity Forecast/Actual:	/ N/A
Altimeter Setting:	29.97 inches Hg	Temperature/Dew Point:	27° C / 24° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Merritt Island, FL (COI)	Type of Flight Plan Filed:	None
Destination:	Merritt Island, FL (COI)	Type of Clearance:	None
Departure Time:	EDT	Type of Airspace:	

Airport Information

Airport:	Merritt Island Airport (COI)	Runway Surface Type:	
Airport Elevation:	6 ft	Runway Surface Condition:	Unknown
Runway Used:	N/A	IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	Unknown

Wreckage and Impact Information

Crew Injuries:	2 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal	Latitude, Longitude:	28.368056, -80.687500

Administrative Information

Investigator In Charge (IIC):	Timothy W Monville	Report Date:	11/19/2015
Additional Participating Persons:	Peter Kandravi; FAA/FSDO; Orlando, FL Jack Clark; FAA/FSDO; Vestavia Hills, AL Richard Pottinger; FAA MIDO; Cleveland, OH Kurt Gibson; Continental Motors, Inc.; Mobile, AL Jason Russell; Liberty Aerospace, Inc.; Melbourne, FL		
Publish Date:	11/19/2015		
Note:	The NTSB traveled to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=89401		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).