Aviation Investigation Final Report

Location:	Murrieta/Temecu, California	**Accident Number:**	LAX08LA066
Date & Time:	February 26, 2008, 13:15 Local	**Registration:**	N811HB
Aircraft:	Bartle Lancair IV-P	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	3 Serious, 1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that the engine lost power while on approach for landing in the amateur-built experimental airplane. Unable to reach the airport, the pilot initiated a forced landing in hilly desert terrain resulting in structural damage to the airframe. Inspection of the modified engine revealed that it was equipped with an electronic ignition system consisting of two capacitive discharge modules with direct crank sensors. Two five-amp fuses in the electrical circuit for the ignition system were found blown. Inspection of the electrical system found no failures of the physical airplane wiring. The pilot, who built the airplane, stated that he designed the ignition system's electrical circuit with the intention of providing electrical redundancy to the ignition system. Examination and testing of the design as installed demonstrated that a minor voltage differential between the main and redundant power source created a condition that routed the current flow for both ignition sources through a single fuse, resulting in a single point of failure. According to the ignition manufacturer, the recommended wiring configuration that would allow ignition power redundancy did not include the addition of a common bus bar as was found on the accident airplane. The positioning of the automotive fuses on the firewall prevented the pilot from accurately identifying the electrical failure.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A total loss of engine power while on approach due to the electrical overload of a fuse caused by the builder's inadequate design and installation of the electrical ignition system.

Findings

Aircraft	Electrical pwr sys wiring - Design
Aircraft	DC power distribution system - Malfunction
Environmental issues	Rough terrain - Contributed to outcome
Personnel issues	Installation - Owner/builder

Factual Information

History of Flight

Approach-VFR pattern final	Sys/Comp malf/fail (non-power)
Approach-VFR pattern final	Loss of engine power (total) (Defining event)
Landing-flare/touchdown	Off-field or emergency landing

HISTORY OF FLIGHT

On February 26, 2008, at 1315 Pacific standard time, an experimental single-engine Bartle Lancair IV-P airplane, N811HB, experienced a loss of engine power while on final approach for runway 18 at French Valley Airport (F70), Murrieta/Temecula, California. The owner/pilot operated the airplane under the provisions of 14 Code of Federal Regulations (CFR) Part 91 as a personal flight. The commercial pilot and two passengers were seriously injured; one other passenger received minor injuries. The airplane sustained structural damage to the entire fuselage during an off-airport landing. Visual meteorological conditions prevailed for the local area flight, and no flight plan had been filed for the flight that originated about 1300 from F70.

The National Transportation Safety Board investigator-in-charge (IIC) interviewed the pilot. The pilot stated that the airplane had about 52 hours of total time. This was his first "big" trip in the airplane, which he had built. The flight departed from Independence, Oregon, for Southern California, the day before the accident. The flight landed about 2.5 hours after takeoff from Independence at Ontario International Airport (ONT), Ontario, California. The day of the accident, he refueled the airplane at ONT and flew to John Wayne-Orange County Airport (SNA), Santa Ana, California, and then flew to F70. The pilot met his family and friends at F70, with the intent of taking them flying. He loaded the first group, and flew them around the area for about 10 minutes. The pilot stated that an uneventful landing was made; he offloaded the passengers, checked the fuel and oil, and then reloaded another group of passengers on the airplane. He reported having about 35 gallons of fuel onboard the airplane.

The pilot stated that the second flight was uneventful and they flew around the area for about 15 minutes. The downwind and base legs of the landing approach were normal. As the airplane turned onto final, the engine lost power. The pilot stated that the engine "just quit, there was no sputtering or surging." The pilot switched fuel tanks, activated the fuel boost pump, and cycled the mixture, but was unable to get the engine to restart. The pilot stated that he realized that they were short of the runway and he was going to have to make an off-airport landing. The pilot readied his passengers for the emergency landing. He chose an open area, and left the landing gear in the down position. About 20 feet above the ground, he selected full flaps and activated the speed brakes. The airplane contacted the ground at 70 knots, the landing gear collapsed, and the airplane slid across the hilly desert terrain and came to stop upright.

The pilot reported that no circuit breakers had been tripped prior to the engine failure.

Responding personnel reported that the wings had not been compromised and there was no fuel leaking from the airplane. They estimated about 25 gallons of fuel remained on board the airplane.

PERSONNEL INFORMATION

A review of the Federal Aviation Administration (FAA) airman and medical records revealed that the 52-year-old pilot held a commercial pilot certificate with ratings for airplane single and multiengine land, and instrument airplane.

The pilot had been issued a third-class medical on May 12, 2006, with the limitation that he shall wear corrective lenses. The pilot reported his total flight hours as 2,245.1 hours.

AIRCRAFT INFORMATION

The airplane was a 2007 experimental Bartle Lancair IV-P, serial number LIV-311. An experimental Teledyne Continental Motors engine, TSIO-500-EXP, serial number TC5169, was installed on the airplane by Performance Engines of La Verne, California.

A Light Speed Engineering (LSE) Electronic Ignition System, consisting of two Plasma III capacitive discharge ignition (CDI) modules with direct crank sensors, serial numbers 43019 and 43032, had been installed on the engine.

TESTS AND RESEARCH

A Safety Board investigator examined the engine. Visual examination of the engine revealed no anomalies other than impact damage to the oil sump and propeller assembly. Investigators rotated the crankshaft and did not observe a spark emanating from the ignition coils. Further inspection of the airplane revealed two 12-volt batteries mounted on the firewall. Adjacent to the outside battery was a fuse box. Recovery personnel related that during the airplane retrieval that they disconnected the battery and removed the fuses to ensure that a fire did not start.

During the engine inspection, the Safety Board investigator examined the fuses and identified the fuses as automotive, with three fuses rated at 5 amps and three fuses rated at 20 amps. The Safety Board investigator observed that two of the three 5 amp automotive fuses had blown. The SB Investigator inserted an intact 5 amp fuse in one of the empty ignition fuse slots.

The crankshaft was rotated and spark was obtained from the ignition coils.

The pilot/builder stated that he designed the ignition system's electrical circuit with the intention of providing electrical redundancy to the ignition system. The owner's electrical wiring diagram for the airplane was reviewed and included the LSE dual electronic ignition system. The review revealed that both the left and right Plasma III CDI units were interconnected through their own individual 5 amp circuit breaker to a common bus bar. The bus bar was then split through two branches to two separate independent batteries. Each branch was made up of a 5 amp automotive fuse in series with an IRSQ04 Schottky diode.

Investigators tested the ignition system for a short circuit between the common bus bar and to the airplane ground with an electric continuity tester. No short circuit was identified. A diode functionality test was performed, with no anomalies noted. The current draw from both CDI units was measured at simulated engine rpm's utilizing a simulated ignition pulse system provided by the ignition manufacturer. The test results were as follows:

RPM - Combined Current draw from both CDI units (Amps)

300	0.9
600	1.8
1200	2.9
1800	4.1
2400	5.3
3000	5.7

According to the airplane kit manufacturer, the Teledyne Continental Motor TSIO-550 engine produces maximum 350 horsepower at 2,600 rpm. The ignition system manufacturer stated that the measured combine current was within normal limits.

In order to test the wiring functionality, investigators replicated the ignition system wiring on a test bench. Two 40-watt automotive lamps were used in place of the CDI units. Power was supplied by a variable power supply (PSU) was used to supply power to the left ignition circuit and 12-volt battery for the right ignition circuit. Current draw for the left and right ignition circuit was measured at the input terminal of each lamp. Investigators incrementally varied the voltage at the PSU and recorded the current draw for both the left and right circuits at each voltage increment. At an increment of .1 volts, the right ignition circuit drew 4.7 amps, and the left ignition drew 0.02 amps. At a voltage differential of 0.68 volts, the right ignition circuit drew 7 amps, and the left ignition circuit drew no current. Shortly thereafter, both automotive fuses blew, extinguishing the lamps.

According to the ignition manufacturer, the recommendation for wiring the dual ignition system to independent power sources required a direct current flow-path to each battery without the use of a common bus bar or serially connected Schottky diodes.

According to an automotive manufacturer fuse data sheet:

"The current rating of a fuse is typically derated 25 percent for operation at 25-degree Celsius to avoid nuisance blowing. For example, a fuse with a current rating of 10 amps is not usually recommended for operation at more than 7.5 amps in a 25-degree Celsius ambient temperature." The data sheet also stated that "Similarly, if that same fuse were operated at a very high ambient temperature of 80-degree Celsius additional derating would be necessary."

ADDITIONAL INFORMATION

According to FAA Advisory Circular AC 20-27F, Certification and Operation of Amateur-Built Aircraft, "Amateur builders are free to develop their own designs or build from existing designs. We do not approve these designs and it would be impractical to develop design standards for the wide variety of design configurations, created by designers, kit manufacturers, and amateur builders."

Pilot Information

Certificate:	Commercial	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	May 12, 2006
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	January 16, 2008
Flight Time:	2245 hours (Total, all aircraft), 52 hours (Total, this make and model), 2063 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bartle	**Registration:**	N811HB
Model/Series:	Lancair IV-P	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	LIV-311
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	January 11, 2008 Annual	**Certified Max Gross Wt.:**	3550 lbs
Time Since Last Inspection:	52 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	52 Hrs at time of accident	**Engine Manufacturer:**	Experimental TCM
ELT:	Installed, not activated	**Engine Model/Series:**	TSIO-500-EXP
Registered Owner:	Henry Bartle Trustee	**Rated Power:**	400 Horsepower
Operator:	Henry Bartle Trustee	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	CNO,650 ft msl	**Distance from Accident Site:**	35 Nautical Miles
Observation Time:	12:53 Local	**Direction from Accident Site:**	315°
Lowest Cloud Condition:	Few / 20000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	14 knots / 21 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	100°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.13 inches Hg	**Temperature/Dew Point:**	25°C / 2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Murrieta/Temecu, CA (F70)	**Type of Flight Plan Filed:**	None
Destination:	Murrieta/Temecu, CA (F70)	**Type of Clearance:**	None
Departure Time:	13:05 Local	**Type of Airspace:**	

Airport Information

Airport:	French Valley Airport F70	**Runway Surface Type:**	Asphalt
Airport Elevation:	1350 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	18	**IFR Approach:**	None
Runway Length/Width:	6000 ft / 75 ft	**VFR Approach/Landing:**	Full stop;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Serious, 1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	
Total Injuries:	3 Serious, 1 None	**Latitude, Longitude:**	36.115985,-119.681175(est)

Administrative Information

Investigator In Charge (IIC):	Cornejo, Tealeye
Additional Participating Persons:	Steve Groover; Federal Aviation Administration; Riverside, CA Klaus Sevier; Light Speed Engineering; Santa Paula, CA
Original Publish Date:	May 6, 2009
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=67585