National Transportation Safety Board
Aviation Accident Final Report

Location:	Venus, FL	**Accident Number:**	ERA14LA183
Date & Time:	04/02/2014, 1940 EDT	**Registration:**	N938VP
Aircraft:	ROBERT J REIMBOLD ZENITH CH 750	**Aircraft Damage:**	Substantial
Defining Event:	Fuel starvation	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The pilot, who was also the builder/owner of the kit airplane, reported that he was en route toward his home airport with each wing tank about 3/4 full. About 50 minutes into the flight, the engine experienced a total loss of power, and the pilot was unable to restart the engine. The pilot conducted an off-airport, forced landing, and the airplane impacted vegetation and came to rest inverted, which resulted in substantial damage to the left wing, vertical stabilizer, and nose structure.

After the airplane came to rest, the pilot turned the fuel selector valve to the “off” position. Examination of the airplane revealed that the left wing fuel tank was devoid of fuel and that the right wing fuel tank contained about 6 gallons of fuel. Further examination revealed that, when the fuel line to the carburetor was removed and the fuel selector was selected to the “on” position, fuel drained freely from the fuel tank. Examination of both fuel tank venting caps revealed no abnormalities that would have precluded normal operation.

According to the fuel system drawing provided by the manufacturer, the fuel line from the right fuel tank runs laterally across the top of the airplane cabin to a T-fitting that is connected to the left tank fuel line. The fuel line then runs down the side of the airplane to the gascolator and the “on/off” shutoff valve. The airplane had no interconnecting fuel venting system, and each fuel tank was independently vented through the fuel caps.

An internet forum on this make and model kit airplane noted the occurrence of several other similar in-flight fuel starvation events. The general consensus of the forum discussion was that the fuel system design led to a partial or complete vacuum being developed during fuel consumption, which resulted in the fuel in the left fuel tank being consumed and a subsequent total power loss and in the right fuel tank being at or near maximum capacity. Therefore, it is likely that the fuel system’s venting was not sufficient to provide adequate positive pressure and that this resulted in a vacuum developing between the right fuel tank and the T-fitting and the subsequent loss of engine power due to fuel starvation.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The fuel system's inadequate design, which resulted in negative pressure in the right fuel tank and a total loss of engine power during cruise flight due to fuel starvation.

Findings

Aircraft	Fuel system - Design (Cause) Fuel - Fluid level (Cause)
Environmental issues	Rough terrain - Contributed to outcome

Factual Information

HISTORY OF FLIGHT

On April 2, 2014, about 1940 eastern daylight time, a kit-built, experimental-amateur built Zenith CH-750, N938VP, was substantial damaged during a forced landing near Venus, Florida. The certificated private pilot and passenger were not injured. The airplane was registered to and operated by a private individual under the provisions of Title 14 Code of Federal Regulations (CFR) Part 91, as a personal flight. Visual meteorological conditions prevailed and no flight plan was filed for the flight, which departed from Lakeland Linder Regional Airport (LAL), Lakeland, Florida, about 1850, and was destined for LaBelle Municipal Airport (X14), LaBelle, Florida.

The pilot reported that prior to departure the fuel gauges indicated approximately three-fourths full for both the left and right fuel tanks; however, he did not visually inspect the fuel quantity. About 18 miles from the destination, the engine lost total power and he attempted to restart the engine. The pilot subsequently made an off airport landing to a pasture. During the off airport landing, the airplane encountered some brush, which separated the nose wheel from the airplane; the airplane nosed over, and subsequently came to rest inverted. He further reported that after the airplane came to rest the fuel selector valve was selected from the "ON" to the "OFF" position and noted that no fuel was leaking from either of the fuel tanks.

A postaccident examination by a Federal Aviation Administration inspector revealed that the left fuel tank was devoid of fuel and the right fuel tank had approximately 6 gallons of fuel remaining. The forward portion of the airplane's fuselage, both wings, and the rudder were substantially damaged. The fuel line to the carburetor was disconnected, the fuel selector valve was placed in the "ON" position, and fuel flowed freely with no debris or restriction noted. The vented fuel caps were examined and no blockage or obstruction was noted around the hole or vents.

PERSONNEL INFORMATION

The pilot, age 75, held a private pilot certificate with a rating for airplane single-engine land, and a third class medical certificate. The pilot reported 1,434 total hours of flight experience, 76 hours of which were in the accident airplane make and model.

AIRCRAFT INFORMATION

The two-seat, high-wing, fixed leading-edge slats, fixed-gear airplane, was manufactured in 2013 and issued a special airworthiness certificate on March 9, 2013. It was powered by a Lycoming O-320-E2D 150-hp engine, driving an Ed Sterba fixed-pitch propeller. The airplane's most recent condition inspection was completed on March 5, 2014 with an airframe total time of 76.3 hours.

METEOROLOGICAL INFORMATION

The 1953 recorded weather observation at Punta Gorda Airport (PGD), Punta Gorda, Florida, located about 26 miles to the west of the accident location, indicated wind from 280 degrees at 6 knots, 10 miles visibility, clear skies, temperature 23 degrees C, dew point 16 degrees C; altimeter setting 30.14 inches of mercury.

ADDITIONAL INFORMATION

The airplane was equipped with two rigid 12-gallon fuel tanks, in which one tank was located in each wing. The fuel system routed fuel, via gravity feed, from the aft side of the fuel tank, through a fingerscreen which was attached to a 3/8 inch inside diameter hose. The fuel hose from the right fuel tank was routed along the top of the airplane cabin to a 3/8 inch Tee where it was connected to the left fuel tank. From the Tee, the fuel line routed down the side of the airplane, inside the side channel on the pilot side, to the gascolator, the fuel "ON/OFF" valve, and then through the firewall to the carburetor. The fuel indication system was an electric float type system. The airplane had no interconnecting fuel venting system and each fuel tank was independently vented through the fuel caps. The fuel system does not, nor was it required to utilize, a fuel boost pump. A note located on the manufacturer provided "fuel line routing" drawing stated "check fuel flow prior to running the engine to ensure proper fuel flow and tank venting. Fuel flow should exceed twice required fuel flow at maximum engine RPM at high angle of attack."

Zenith Aircraft Builders and Flyers Internet Forum

According to several postings on the forum dated between May 18, 2011, and August 24, 2011, revealed similar in flight fuel starvation issues. The general consensus of the forum discussion supported that a partial or complete vacuum developed during fuel consumption, which resulted in the fuel in the left fuel tank being consumed prior to the total power loss and the right fuel tank being at or near maximum capacity. One comment reported that the fuel caps provided with the kit were replaced with fuel caps that had a tube protruding forward in the airstream to provide a "positive pressure" within the fuel tanks. Several of the comments revealed that after landing the fuel quantity would equalize in each fuel tank.

CFR 23.975(a)(3) "Fuel tank vents and carburetor vapor vents" stated "The venting capacity must allow the rapid relief of excessive differences of pressure between the interior and exterior of the tank."

Advisory Circular 90-89A "Amateur-Built Aircraft and Ultralight Flight Testing Handbook" Chapter 1, Section 11 "Additional Engine Tests" 4e(2) stated in part "...with minimum fuel in the tanks, disconnect the fuel line to carburetor. The fuel flow with a gravity flow system should be 150 percent of the fuel consumption of the engine at full throttle..."

History of Flight

Enroute-cruise	Fuel starvation (Defining event) Loss of engine power (total)
Emergency descent	Off-field or emergency landing
Landing-landing roll	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Private	**Age:**	75
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With Waivers/Limitations	**Last Medical Exam:**	04/03/2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	09/30/2013
Flight Time:	(Estimated) 1434 hours (Total, all aircraft), 76 hours (Total, this make and model), 31 hours (Last 90 days, all aircraft), 9 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	ROBERT J REIMBOLD	**Registration:**	N938VP
Model/Series:	ZENITH CH 750	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental Light Sport	**Serial Number:**	75-8566
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	03/05/2014, Conditional	**Certified Max Gross Wt.:**	1320 lbs
Time Since Last Inspection:	6 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	76.3 Hours	**Engine Manufacturer:**	Lycoming
ELT:	C91A installed, not activated	**Engine Model/Series:**	O-320-E2D
Registered Owner:	REIMBOLD ROBERT J	**Rated Power:**	150 hp
Operator:	REIMBOLD ROBERT J	**Air Carrier Operating Certificate:**	None

Meteorological Information and Flight Plan

Observation Facility, Elevation:	KPGD, 25 ft msl	**Observation Time:**	2053 EDT
Distance from Accident Site:	26 Nautical Miles	**Condition of Light:**	Night/Dark
Direction from Accident Site:	263°	**Conditions at Accident Site:**	Visual Conditions
Lowest Cloud Condition:	Clear	**Temperature/Dew Point:**	23°C / 16°C
Lowest Ceiling:	None	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	6 knots, 280°	**Visibility (RVR):**	
Altimeter Setting:	30.14 inches Hg	**Visibility (RVV):**	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Lakeland, FL (LAL)	**Type of Flight Plan Filed:**	None
Destination:	La Belle, FL (X14)	**Type of Clearance:**	None
Departure Time:	1850 EDT	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None		

Administrative Information

Investigator In Charge (IIC):	Shawn Etcher	**Adopted Date:**	06/22/2015
Additional Participating Persons:	Lester Abreu; FAA/FSDO; Miramar, FL		
Publish Date:	06/22/2015		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=89016		