Aviation Investigation Final Report

Location:	Bristol, Wisconsin	**Accident Number:**	CEN15FA315
Date & Time:	July 25, 2015, 11:17 Local	**Registration:**	N9601
Aircraft:	SANFORD ZENITH CH 601XL	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot was flying his experimental, amateur-built airplane on a cross-country flight. GPS and radar data showed that, about an hour into the flight, the airplane turned left and then turned right. About 1 minute later, the airplane's groundspeed slowed to below its stall speed, and the airplane then entered a steep descent. Witnesses reported seeing the airplane "corkscrew" downward, and one witness reported that the propeller was "not spinning." Flight control continuity was confirmed, and witness marks on the propeller blades were consistent with the propeller not rotating at impact.

A pilot who shared a hangar with the accident pilot reported that the accident pilot replaced the airplane's ignition system coils the day before the flight. Postaccident examination of the engine revealed that the coils were not engine-manufacturer replacement parts. During a postaccident test run, the engine would not start. During subsequent troubleshooting, the right distributor center coil tower socket was found separated; further examination revealed that it failed due to overload. The right ignition coil was then connected to the left distributor cap, and the engine operated normally during the subsequent test run. The broken right distributor cap was then replaced with a new cap, the right ignition coil was connected to the new cap, and the engine again operated normally during a subsequent test run. The left ignition coil did not produce any sparks during the test runs. No other anomalies were observed during the engine runs that would have prevented normal operation. The airplane likely experienced a loss of engine power due to the ignition issues, and the pilot failed to maintain adequate airspeed, which resulted in a subsequent stall and loss of airplane control.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's failure to maintain airspeed and airplane control following a loss of engine power during cruise flight. Contributing to the accident was the installation of ignition system coils that were not engine-manufacturer replacement parts, which subsequently failed and resulted in the loss of engine power.

Findings

Personnel issues	Aircraft control - Pilot
Aircraft	Airspeed - Not attained/maintained
Aircraft	(general) - Not attained/maintained
Aircraft	Recip eng wiring - Failure
Aircraft	Recip eng wiring - Incorrect service/maintenance
Personnel issues	Installation - Pilot

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Enroute-cruise	Loss of engine power (total) (Defining event)
Enroute-cruise	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On July 25, 2015, about 1117 central daylight time, a Sanford Zenith CH 601XL experimental amateur-built airplane, N9601, impacted terrain as it descended near the Binzel Airport (WI95), Bristol, Wisconsin. The private pilot and one passenger were fatally injured. The airplane sustained substantial damage. The airplane was registered to and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Day visual flight rules conditions prevailed for the flight, which did not operate on a flight plan. The flight originated from the Porter County Regional Airport (VPZ), near Valparaiso, Indiana, about 1017 and was destined for Oshkosh, Wisconsin.

According to fueling records, the airplane was serviced with 16.7 gallons of aviation gasoline (avgas) at VPZ on July 25, 2015.

According to GPS data, the accident airplane took off from VPZ about 1017. According to radar data from the Federal Aviation Administration (FAA), it appeared on radar about two miles northwest of Hobart Sky Ranch Airport, near Hobart, Indiana. Near the end of the flight, about 1115, the airplane turned left, and then about 1116, the airplane turned right. About 1117:20, the airplane's groundspeed began to slow and the airplane began to descend from 1,722 feet MSL to a last recorded GPS data point of 1,152 feet MSL. From 1117:20 until the end of the recording at 1117:32, the airplane's lateral position changed by about 600 feet. The data showed the airplane's groundspeed slowed to 45 knots and slower during the final recorded data points.

A witness driving on a nearby highway said, "My sister and I were looking to the left at the scenery we were passing and saw a small white plane do two corkscrew-type twirls and dropped nose down behind the tree line out of sight. We think it occurred approximately 11:00 a.m. We did not see any explosion or hear any noise during the crash and thought it was a large model plane since it did not seem like the size of a small manned plane to us."

Another witness who was working in the area reported that he saw a "bright shine" and then saw a small airplane. The airplane was "corkscrewing, going around, around, and around, maybe 10 times." He thought the airplane was not coming down to land. The witness said the propeller was "just sitting there, not spinning." He thought the event occurred about 1130, basing this on his completing the job he was working at the time.

When the accident airplane did not reach its destination, a family member reported it missing. The Civil Air Patrol was contacted and asked to assist in locating the airplane. The airplane was found in an open

field about 670 feet and 65 degrees from the north end of WI95's runway about 1228 on July 26, 2015.

Pilot Information

Certificate:	Private	**Age:**	69,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 27, 1979
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	250 hours (Total, all aircraft)		

The 69-year-old pilot held a FAA private pilot certificate with an airplane single-engine land rating. He also held a second-class medical certificate that was issued on August 27, 1979, with a limitation that he must wear corrective lenses. The pilot reported on the application for that medical certificate that he had accumulated 250 hours of total flight time and accumulated no flight time in six months prior to that application. According to a witness, the pilot received 10 hours of dual time in the airplane with a flight instructor to comply with an insurance requirement.

The passenger did not hold a pilot certificate but had been reported to have taken flight training.

Aircraft and Owner/Operator Information

Aircraft Make:	SANFORD	**Registration:**	N9601
Model/Series:	ZENITH CH 601XL	**Aircraft Category:**	Airplane
Year of Manufacture:	2008	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	0002
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	June 11, 2015 Condition	**Certified Max Gross Wt.:**	1320 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	JABIRU
ELT:	C91A installed, not activated	**Engine Model/Series:**	3300
Registered Owner:	On file	**Rated Power:**	110 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane, a Sanford Zenith CH 601XL, was an all-metal, two-seat side-by-side, fixed tricycle landing gear airplane. According to FAA airworthiness documents, the accident airplane was produced

from a kit by a builder and it received an airworthiness certificate in the Experimental, Amateur Built category on July 2, 2008. The airplane was powered by a 120-horsepower, Jabiru 3300A engine with serial number 33A 1380, which drove a Sensenich composite, ground adjustable, two-bladed propeller. According to the kit manufacturer's website, the airplane's stall speed with no flaps extended was 51 mph (about 44.32 knots).

The airplane was equipped with a Dynon FlightDEK-D180 seven-inch wide screen display unit. The unit's primary functions include attitude, airspeed, altitude, vertical speed, gyro-stabilized magnetic compass, slip/skid ball, turn rate, clock, timers, g-meter, and horizontal situation indicator. This instrument features ADAHRS (Air Data, Attitude and Heading Reference System), which integrates over a dozen solid-state sensors. The unit can continuously monitor up to 27 available sensor inputs that cover the engine, fuel and other miscellaneous systems and annunciate any abnormality immediately upon detection. The Dynon's internal memory is capable of logging data depending on the firmware version installed in the unit. The data logging must be configured by the operator to enable logging and set the data log interval. The unit can also be configured to start logging data automatically at boot-up. The data logging interval can be set to store at 1, 3, 5, 10, 30, or 60-second intervals. The internal memory can store at least 30 minutes of cumulative data at a 1-second recording interval or at least 30 hours at a 60-second data recording interval. When the recording limit in the internal memory is reached, the oldest record is dropped and a new record is added.

The airplane was also equipped with a Garmin GPSMAP 396 unit. The unit is a battery-powered, portable 12-channel GPS receiver with a 3.8-inch 256-color TFT LCD display screen that can show a color moving-map and it has terrain-alerting features along with satellite datalink graphical weather. The unit includes a built-in Jeppesen database. The unit stores date, route-of-flight, and flight-time information. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 500 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed track log including latitude, longitude, date, time, and GPS altitude information is stored within the unit whenever the receiver has a lock on the GPS navigation signal.

A witness, who shared a hangar with the accident pilot, purchased the accident airplane from an individual in Texas. At purchase, the airplane had damage to its propeller, leading edges, and horizontal stabilizer. He indicated that the airplane "got away" from the individual in Texas when he exited the airplane while running to close the hangar door. The airplane upgrade modification had been completed before being damaged and the airplane did not have an engine stoppage during the damaging event. The accident pilot and the witness did all the repairs to the airplane and had an airframe and powerplant mechanic look over the repairs as they progressed. The accident pilot registered the airplane. The mechanic did the annual inspection, and signed off the logbook.

According to this witness, the airplane had known issues. In the year before the accident, on a flight from Louisville, Kentucky, to Phoenix, AZ, 10 minutes into the flight the accident pilot felt a vibration. He returned to the airport, removed the cowling, and troubleshot for the vibration issue. However, he could not find the cause. He subsequently did a run up, a few high-speed taxi tests, and determined it the airplane was okay to fly. He departed again and about an hour into this flight, he noticed the vibration return, so he landed at an airport. The pilot and witness inspected the airplane and found the engine to have a weak spark. The accident pilot bought replacement coils at a "mower shop" as he was told they were the same. They installed the newly purchased coils, the airplane subsequently ran with no issues,

and the accident pilot returned without further incident.

The accident pilot flew the airplane for several hours without any further coil issues. The witness indicated the condition inspection was completed on June 11, 2015. The witness stated that two problems were found that needed to be corrected. The nose wheel bushings were too short and needed to be replaced along with the propeller's locking washers. Both items were ordered and replaced. The accident airplane was flown for several hours with no issues. The accident pilot wanted the cold start coils option and he ordered them. The witness reported that the pilot was going to install the cold start coils. The witness got the news of the pilot's missing airplane on Sunday afternoon, the day after the accident. The witness went to the airport and learned the passenger helped the pilot replace the coils on Friday, the day before the accident. The witness found the cold start coil on the workbench and the coil exhibited wear on one side of the pick-up along with a purple spot.

The witness indicated that the proper way to install the coils is by use of two feeler gauges. The flywheel magnets are very strong and without two gauges, it can allow one side to move while tightening the other. The witness thought that the accident pilot and passenger only had one feeler gauge.

The witness reported that he had built three Zenith 601s and had completed 20 upgrade modifications for the kit manufactured. He further indicated that the accident airplane was "solid" and the engine was "strong."

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KENW,743 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	11:35 Local	**Direction from Accident Site:**	76°
Lowest Cloud Condition:	Scattered / 2000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 4000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	310°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	28°C / 23°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	VALPARAISO, IN (VPZ)	**Type of Flight Plan Filed:**	None
Destination:	Oshkosh, WI	**Type of Clearance:**	None
Departure Time:	10:17 Local	**Type of Airspace:**	

At 1135, the recorded weather at the Kenosha Regional Airport, near Kenosha, Wisconsin, was: wind 310 degrees at 9 knots; visibility 10 statute miles; sky condition scattered clouds at 2,000 feet, broken clouds at 4,000 feet; temperature 28 degrees C; dew point 23 degrees C; altimeter 29.94 inches.

Airport Information

Airport:	BINZEL WI95	**Runway Surface Type:**	Grass/turf
Airport Elevation:	705 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	18	**IFR Approach:**	None
Runway Length/Width:	2000 ft / 40 ft	**VFR Approach/Landing:**	

WI95 was a private, non-towered airport, which was owned by an individual. It was located about four miles east of Paddock Lake, Wisconsin. The airport had an estimated elevation of 705 feet MSL. The airport's runway 18/36 was a 2,000 feet by 40 feet runway with a turf surface. Runway 18 obstruction remarks listed 40-foot trees located 60 feet from the runway.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	42.58139,-88.011665

The airplane came to rest upright about one-quarter mile and 110 degrees from the intersection of 60th Street and 172nd Avenue in Bristol. The airplane's resting heading was about 310 degrees. One propeller blade remained intact and attached to the hub and the other blade was broken into three sections. The inboard section remained attached to the hub. The outboard blade section was found embedded in terrain about eight feet north of the hub. The embedded blade section exhibited abrasions perpendicular to the blade's chord. The intact blade exhibited no abrasions. The empennage remained attached to the fuselage. The top of the rudder was displaced rearward and it exhibited a wrinkle deformation below that displacement. Both wings exhibited chrodwise wrinkle deformations inboard of their approximate midspans. The forward portion of the fuselage was deformed where it met the canopy. The sides of the fuselage above each wing were deformed between the end of the canopy and the firewall. The right wing fuel tank did not contain any fuel and disassembly of its leading edge revealed the right fuel tank was breached. The left fuel tank contained a blue colored liquid that had a smell consistent with Avgas. The fuel tank selector valve was on the left tank. The gascolator contained a liquid consistent with Avgas. The carburetor bowl was removed and it contained a blue colored liquid that had a smell consistent with Avgas. Flight control continuity was established from the cockpit flight controls to their respective flight control surfaces. Both flaps moved in the same direction when each was manipulated by hand. The flap's actuator control rod separated from its flap linear actuator. No preimpact anomalies were detected that would have prevented normal flight operations.

Medical and Pathological Information

The Kenosha County Medical Examiner's Office arranged for an autopsy to be performed on the pilot along with taking toxicological samples. The pilot's autopsy indicated that his cause of death was due to multiple blunt force injuries.

The FAA Civil Aerospace Medical Institute prepared a Final Forensic Toxicology Accident Report on the samples taken during the pilot's autopsy. The report, in part, indicated:

182 (mg/dl) Glucose detected in Vitreous
6.6 (%) Hemoglobin A1C detected in Blood

Tests and Research

The accident engine was removed from the airplane, crated, and shipped to a representative of its manufacturer, Jabiru USA, in Shelbyville, Tennessee, for examination. When uncrated under National Transportation Safety Board (NTSB) supervision, the representative observed that the exhaust was missing and the carburetor heat shield was damaged. The carburetor had been liberated at the accident site and it was observed subsequently installed at an angle. The representative observed that the ignition coils were not genuine Jabiru ignition coils and that the lead from the right ignition coil was loose in the distributor cap socket. The engine was mounted on the engine run stand, oil was added, and engine controls and sensors were hooked up. The engine was turned over by the starter to build oil pressure and get the engine in condition for operation. Fuel was observed leaking from the carb bowl and the carb throat. The initial attempt at engine start was unsuccessful. An attempt to remove the ignition coil lead from the distributor cap was tried and in doing so, the center tower socket came loose from the cap rendering the cap unusable. Spark from the right ignition coil was observed and there was no evidence of spark from the left coil when the engine was motored over by the starter. The right coil lead was connected to the left distributor center tower socket. The engine was motored over by the starter and the engine started and ran using the right coil connected to the left distributor cap. The broken right distributor cap was replaced with a new cap. The engine then started and ran normally through its normal operating range on the right coil and distributor. It would not run on the left side ignition, reconfirming the diagnosis of an inoperative left ignition coil. No other anomalies were observed during the engine run that would have prevented normal engine operations.

The right distributor was removed from the engine and shipped to the NTSB Materials Laboratory where the Chief of the Materials Laboratory Division examined the distributor in detail, documented the separation, and produced a Materials Laboratory Factual Report.

According to the Material Laboratory report, images of the top of the distributor cap documented the

center socket tower separation features, which showed that the fracture initiated at a step (change in material thickness) created by a boss (protruding feature on a workpiece surface). Scanning electron fractographs of the fracture initiation region also indicated that the fracture initiated on the inside of the distributor cap dome at a step created by a boss molded into the inside dome of the distributor cap. The hackle and fine fibril fracture surface features, as well as the large fibrils at the outer surface of the cap, are consistent with an overstress fracture mode due to bending forces applied to the center coil socket tower. No evidence of progressive cracking, such as fatigue or slow crack growth, was noted. The materials laboratory factual report is appended to the docket material associated with this investigation.

An NTSB air traffic control specialist acquired radar data from the FAA. The data was examined and the flight's data was extracted and graphically plotted. The plotted radar data is appended to the docket material associated with this investigation.

The accident airplane's GPS and Dynon FlightDEK D180 were removed from the airplane and shipped to the NTSB Vehicle Recorder Division where a senior recorder specialist examined the devices, downloaded and documented data from them, and produced a specialist's factual report. The specialist's recorder factual report is appended to the docket material associated with this investigation.

According to the recorder specialist's report, an exterior examination revealed the GPS unit had sustained minor screen impact damage. The screen was replaced and the unit powered on normally. Screens were photo-documented and information was downloaded using the manufacturer's software. Once powered up, the "Active Goto" screen indicated the flight's input destination was the Fond du Lac County Airport (KFLD), near Fond du Lac, Wisconsin. The GPS downloaded data included 76 recording sessions from August 23, 2014, through July 25, 2015. The accident flight was the last session, recorded starting at 1011:35 and ending at 1117:32 on July 25, 2015 (381 total data points).

Examination of the Dynon FlightDEK D180 data revealed that the unit had not sustained any damage. Its information was extracted using the manufacturer's software normally, without difficulty. The accident Dynon device was running software version 5.5.0.249 and its configuration was found to be setup to record data every 10 seconds. A total of 2,948 data points were recovered; however, the device was not configured with a GPS input and the Dynon clock periodically reset to "00:00:00," coincident with each new recording. The accident flight was identified as the last recording and it contained 398 datapoints. The flight's data was recorded in elapsed time from the start of the recording. The Dynon's altitude, airspeed, and heading data were graphically aligned with the GPS's altitude, groundspeed, and track data. The offset of each device's recording was adjusted until their best-fit graphical alignment was achieved.

The Dynon's data revealed that during the accident flight the airplane initially climbed to about 3,000 feet pressure altitude after departure and subsequently descended to about 2,000 feet pressure altitude for most of the flight. Other than the middle and end of the recording, engine parameters remained fairly steady throughout the flight. The last two datapoints after 1117:02 (1117:12 and 1117:22) showed a change in altitude, decreasing oil pressure, decreasing RPM, decreasing EGT, increasing CHT, an increase in the airplane's pitch attitude to about 14 degrees, a subsequent decrease in pitch, and decreasing indicated airspeed.

Administrative Information

Investigator In Charge (IIC):	Malinowski, Edward
Additional Participating Persons:	Ray P Yank; Federal Aviation Administration; Milwaukee, WI Pete Krotje; Jabiru USA Sport Aircraft, LLC; Shelbyville, TN Matt Heintz; Zenair Ltd.; Ontario
Original Publish Date:	February 8, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=91630