Aviation Investigation Final Report

Location:	Cody, Wyoming	**Accident Number:**	CEN17LA065
Date & Time:	December 23, 2016, 10:13 Local	**Registration:**	N320RJ
Aircraft:	LUECK KITFOX 7	**Aircraft Damage:**	Substantial
Defining Event:	Collision during takeoff/land	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The commercial pilot stated that he had experienced engine roughness during previous flights in the accident airplane. Maintenance personnel determined that the airplane was not receiving adequate fuel at full power, even with both electric fuel pumps operating. As a result, they installed check valves in the fuel system and replaced the fuel pressure regulator. On the day of the accident, the engine experienced a total loss of power after both fuel pumps were turned off during a pre-takeoff engine run-up. The pilot and mechanic then performed another run-up check, during which the engine operated normally. The pilot subsequently departed and entered the airport traffic pattern. While on the downwind leg, with both fuel pumps operating, the pilot reduced engine power and the engine experienced a total loss of power. The pilot performed a forced landing to a field, during which the nose landing gear collapsed.

Postaccident examination of the engine revealed that the fuel pressure and airbox pressure differential was not within the engine manufacturer's limits. The fuel pressure regulator was adjusted within those limits, and the engine was subsequently test run with no anomalies.

Probable Cause and Findings

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

Improper maintenance of the fuel pressure regulator, which resulted in an excessive fuel and airbox pressure differential and subsequent loss of engine power.

Findings

Personnel issues	Scheduled/routine maintenance - Maintenance personnel
Aircraft	Fuel pressure - Incorrect service/maintenance
Aircraft	Fuel pressure - Capability exceeded
Aircraft	(general) - Failure

Factual Information

History of Flight

Approach-VFR pattern base	Loss of engine power (partial)
Approach-VFR pattern base	Attempted remediation/recovery
Emergency descent	Loss of engine power (partial)
Landing	Off-field or emergency landing
Landing-landing roll	Collision during takeoff/land (Defining event)
Landing-landing roll	Nose over/nose down

On December 23, 2016, at 1013 mountain standard time, a Kitfox 7, N320RJ, experienced a loss of engine power during a visual approach from the airport traffic pattern at Yellowstone Regional Airport (COD), Cody, Wyoming. The pilot performed a forced landing to a field where the airplane nosed-over and impacted terrain. The commercial pilot was uninjured. The airplane received substantial damage. The airplane was registered to and operated by an individual under 14 *Code of Federal Regulations* Part 91 as a pilot proficiency flight. Visual meteorological conditions prevailed for the flight that was not operating on a flight plan. The flight originated from COD about 1000 and was to remain in the airport traffic pattern.

The pilot was employed as a flight instructor for Choice Aviation at COD. The pilot stated that the airplane was owned by a former student of his, who was issued a private pilot certificate in November 2016. The pilot stated that he had provided all the airplane owner's flight training toward his private pilot certificate, using a Cessna 172M operated by Choice Aviation. The airplane owner planned on flying the accident airplane and had Choice Aviation perform a condition inspection on October 20, 2016. The airplane owner wanted the pilot to fly the airplane to gain proficiency so that the owner could receive flight instruction from the pilot using the accident airplane.

On November 5, 2016, the pilot and the chief pilot of Choice Aviation performed a checkout flight in the accident airplane, but the flight returned and landed without incident shortly after takeoff due to engine roughness. The airplane then underwent maintenance at Choice Aviation where it was determined that the it was not receiving enough fuel at full power, even with both electric fuel pumps on. Check valves were installed in the fuel system, and the fuel pressure regulator was replaced.

On December 22, 2016, the pilot and chief pilot performed a second checkout flight in the accident airplane, during which there was "slight engine roughness" at high power settings, which was not "as bad" as what had occurred on the previous checkout flight. The airplane "ran perfectly fine" at 35 inches of manifold pressure and below. The pilot and chief pilot performed power off stalls, steep turns, climbs and descent as well as three takeoffs and landings, and the airplane "flew normal."

The pilot stated that to fix the remaining fuel issue at high power settings, a Choice Aviation mechanic adjusted the fuel pressure to the maximum setting for the engine to receive more fuel needed to run at maximum engine power.

On the day of the accident, the pilot flew another flight in the accident airplane to gain further proficiency in the handling characteristics of the airplane. The pilot stated that prior to the flight, he performed a "thorough" preflight inspection of the airplane, and the inspected items were in "working order." The pilot performed "several" start attempts and had to use the choke to start the engine in cold weather conditions. While holding short of runway 22 for takeoff, the pilot ran the engine to 4,000 rpm and checked the ignition circuits. He then turned fuel pump "B" on and ran the engine to maximum power, which brought the fuel pressure to 23 psi; the engine ran "fine." The pilot said that on previous flights, the engine would not run "smoothly" at maximum power settings. The pilot said that when he reduced engine power to 4,000 rpm and turned off both pumps, the engine "slowly quit." He then restarted the engine and taxied to maintenance to confirm normal operation of the engine with the mechanic. The airplane engine was then run-up with the pilot and the mechanic, and the engine remained in limits from maximum power to idle with both fuel pumps on. With both fuel pumps off, the fuel pressure dropped, and the engine did not quit. The mechanic exited the airplane, and the pilot taxied the airplane to runway 22 and performed another run-up at 4,000 rpm with both fuel pumps on and "everything checked out."

The pilot then performed a takeoff from runway 22 and entered a left crosswind, during which the pitot tube rotated sideways resulting in an airspeed indication of 0 knots. The pilot then flew a left traffic pattern to land on runway 22. While in a left downwind and abeam the runway numbers, the pilot reduced engine power to 15 inches of manifold pressure, with both fuel pumps on, to begin a descent. He "sensed" something was not right with the engine so he applied power and there was no response. He turned the airplane onto a left base and maintained what he thought was the pitch attitude for best glide. The propeller continued to turn, but after multiple attempts to adjust the throttle, he realized that the engine was not responding. The pilot performed a forced landing in a grass field short of runway 22 due to a snow bank near the approach end of the runway. During the landing, the airplane rolled for about 75 feet until the nose landing gear collapsed. The airplane then slid for about 90 feet.

Examination of the airplane revealed that a black color fuel line to the pressure regulator was ¼ inch in diameter. The absolute pressure sensor was not mounted using a screw through its mounting hole. The absolute pressure sensor, "966 507," was attached to the engine frame using a black-color substance consistent with sealant in front of and toward the bottom of airplane battery, which was mounted on the right side of the firewall, as viewed from tail-to-nose. The airplane contained useable fuel in the left and right fuel tanks consistent in color with 100 low lead aviation fuel. The left and right wing filler cap vents were unobstructed. The pitot tube was rotated laterally so that the pitot tube inlet was pointed inward toward the fuselage. The airplane engine did not exhibit any leaks of fuel, oil, or coolant. Engine control continuity from the cockpit control to the engine was confirmed. The pressure regulator, "887 130, 16.0280," exhibited a gouge on the side of the its adjustment screw retaining nut. The fuel selector was in the off position. All the fuel line shut off valves were in the on position. The Hobbs meter indication was 109.7 hours.

In preparation of an engine run, the oil quantity level was checked by rotating the propeller by hand until a burp was heard from the engine oil reservoir. The engine oil level then rose, and its quantity was at the base of the oil filler neck, which was above the maximum oil capacity for the engine. The excess engine

oil was drained and estimated to be about 16 ounces above the maximum oil capacity for the engine. The propeller was removed due to accident damage and replaced for the engine run. The airplane was then tied down and was started after six start attempts over about a 1:00 minute period. The engine was then run for about 5:30 minutes to a full-power setting without power loss. To replicate the accident flight, a second engine run was then performed during which the engine was run at a full power setting and then retarded to 15 inches of manifold pressure. When engine power was retarded to a manifold pressure of 15 inches, with both fuel pumps in the on-position, the engine quit and was unable to be restarted. Fuel lines were examined after the engine run. The black color fuel line, leading to the fuel pressure regulator, contained fuel and exhibited pressure when the fuel pumps were on; the return fuel line contained fuel. The engine was unable to be started after several attempts. The airplane interior was removed to examine the fuel system/lines for leakage/obstruction and none were noted. A transparent-green color fuel return line from the pressure regulator was connected toward the bottom left side of the fuel header tank behind the passenger seat. There was a second transparent-green color line connected to the top of fuel header tank that had a transducer spliced into the line which was connected to the right fuel tank via the wing root. The transducer, of undetermined function, was at a distance midpoint between the top of the header tank and the right-wing root. Fuel was present up to the transducer but there was no fuel present in the line above the transducer throughout the examination/engine runs. Black color fuel lines from the left and right-wing fuel tanks were connected toward the bottom of the fuel header tank. The fuel pressure regulator fuel return line was disconnected from the pressure regulator's return port, and a fuel hose was connected from pressure regulator's return port and inserted into the right-wing filler port. A dual needle pressure gauge was attached to the pressure regulator and induction manifold as per the engine maintenance manual. After several engine start attempts, the engine was started and the fuel pressure needle was about 62.5 inches and the manifold pressure was about 29 inches. When engine power was reduced to about 17 inches of manifold pressure with the fuel pumps on, the engine quit. The pressure regulator screw was turned one turn toward decreasing fuel pressure. The engine was started with less start attempts of shorter duration and was run again. The fuel pressure and manifold pressure had a differential of about 5 inches. The engine was run at full power and then at 15 inches with and without the fuel pump on and there was no loss of engine power. The throttle was cycled between full power and 15 inches with the fuel pumps on and there was no loss of engine power.

According to Rotex 914 Fuel Pressure Regulator maintenance information, the "maximum fuel pressure is approximately 10.3 inches of mercury (5.08 psi) above airbox pressure. The minimum fuel pressure is approximately 4.44 inches of mercury (2.18 psi) above the airbox pressure. The fuel pressure regulators are "PRE-SET at the factory and RARELY need adjustment if at all…EVER!"

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	23,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	August 19, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	August 5, 2016
Flight Time:	467 hours (Total, all aircraft), 1 hours (Total, this make and model), 403 hours (Pilot In Command, all aircraft), 107 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	LUECK	**Registration:**	N320RJ
Model/Series:	KITFOX 7	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	S70507084
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	October 20, 2016 Condition	**Certified Max Gross Wt.:**	1550 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	39 Hrs as of last inspection	**Engine Manufacturer:**	Rotax
ELT:	Installed	**Engine Model/Series:**	914UL
Registered Owner:	On file	**Rated Power:**	115 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	COD,5102 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	09:56 Local	**Direction from Accident Site:**	80°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	29.81 inches Hg	**Temperature/Dew Point:**	-9°C / -16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Cody, WY (COD)	**Type of Flight Plan Filed:**	None
Destination:	Cody, WY (COD)	**Type of Clearance:**	None
Departure Time:	10:00 Local	**Type of Airspace:**	Class E

Airport Information

Airport:	Yellowstone Regional Airport COD	**Runway Surface Type:**	Asphalt
Airport Elevation:	5102 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	22	**IFR Approach:**	None
Runway Length/Width:	8268 ft / 100 ft	**VFR Approach/Landing:**	Forced landing;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	44.527221,-109.010833(est)

Administrative Information

Investigator In Charge (IIC):	Gallo, Mitchell
Additional Participating Persons:	Abbie Otis; Federal Aviation Administration; DEN FSDO; Denver, CO
Original Publish Date:	September 6, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=94552