Aviation Investigation Final Report

Location:	West Creek, New Jersey	**Accident Number:**	ERA17LA182
Date & Time:	May 16, 2017, 20:30 Local	**Registration:**	N9366K
Aircraft:	Stinson 108	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot reported that, while en route on a cross-country flight, the engine began to "shake." The pilot attempted to return to the airport; however, the engine experienced a total loss of power. The pilot subsequently initiated an emergency descent; however, the airplane struck trees and terrain about 1 mile from the approach end of the runway.

The crankshaft and remaining cylinders remained intact, and the engine crankshaft rotated smoothly when the propeller was turned by hand. The No. 4 cylinder's exhaust pushrod shroud and exhaust pushrod were both bent. An examination of the engine revealed that the No. 4 cylinder was fracture-separated from the crankcase. The piston, sections of the No. 4 cylinder, and sections of the crankcase were missing. The No. 4 exhaust valve stem was fractured about halfway along its length, and the fracture surface was consistent with reverse bending fatigue crack propagation, which typically results from a stuck valve. The lower half of the stem and face were missing. The No. 4 exhaust valve guide clearance was excessive, and the valve's guide and tip area contained carbon deposits. The cylinder walls contained circular gouges consistent with the exhaust valve face diameter. It is likely that the carbon deposits on the valve stem resulted in the valve getting stuck, which initiated the reverse bending fatigue crack and led to the exhaust valve face stem fracturing and dropping into the cylinder and the subsequent catastrophic engine failure. The engine maintenance records were incomplete and prevented a determination of when the last clearance check of the No. 4 cylinder was performed or when it was last overhauled/replaced.

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 due to the No. 4 cylinder's exhaust valve getting stuck and the subsequent fracturing of the valve face stem.

Findings

Aircraft	Recip eng cyl section - Fatigue/wear/corrosion
Aircraft	Recip eng cyl section - Failure
Environmental issues	Tree(s) - Contributed to outcome

Factual Information

History of Flight

Prior to flight	Miscellaneous/other
Initial climb	Loss of engine power (total) (Defining event)
Landing	Off-field or emergency landing
Landing	Collision with terr/obj (non-CFIT)

On May 16, 2017, about 2030 eastern daylight time, a Stinson 108-2, N9366K, was substantially damaged during a forced landing near West Creek, New Jersey. The private pilot received minor injuries. The airplane was privately owned and operated. The personal flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and a visual flight rules flight plan was filed for the cross-country flight. The flight originated from Eagles Nest Airport (31E), West Creek, New Jersey, around 2020, and was destined for Frederick Municipal Airport (FDK), Frederick, Maryland.

According to the pilot, he departed earlier that morning from FDK, flew to Sanford, Maine, and was returning to FDK, with several scheduled fuel stops. Throughout the day, he landed at seven airports, and reported no anomalies with the airplane. Before he departed 31E for the final leg of the flight back to FDK, he topped the airplane off with 26 gallons of fuel. After departure, the pilot flew toward the coast of New Jersey, and about 2,000 ft mean sea level, the engine began to "shake." He immediately turned the airplane back toward 31E, and soon after the engine lost all power. Smoke filled the cockpit and the pilot noticed an "orange glow" under the floor boards near the firewall. The pilot initiated an emergency descent, turned the fuel selector to the off position, and noted that the "orange glow" stopped. The pilot attempted to return to 31E, however, the airplane struck trees and terrain about 1 mile from to the approach end of the runway.

Examination of the wreckage by a Federal Aviation Administration Inspector revealed that it came to rest in a near vertical attitude. Both wings exhibited leading edge crush damage and the empennage was bent toward the right. The engine remained attached to the airframe. Examination of the engine revealed a breach in the top section of the crankcase.

According to FAA records, the airplane was manufactured in April 1947. It was equipped with a Franklin 6A4-165-B3, a 165-hp, engine. The most recent 100-hr inspection was performed on September 16, 2016, at a Tachometer time of 1039.6. According to the engine maintenance logs, the valve clearances were checked on the engine when the Nos. 3 and 6 cylinders were replaced for low compression on June 19, 2015, at a tachometer time of 945.3 hours. In addition, the Nos. 2 and 5 cylinders were replaced for low compression on September 16, 2016, at a tachometer time of 1039.6 hours. The maintenance records did not note another valve clearance check or have a recorded overhaul since the engine was rebuilt in 1970 and no information about engine operation from June 24, 1971 through June 19, 2015. Furthermore, the manufacturer recommended valve clearance check was every 200 hours at a minimum and overhaul was at 600 to 700 hours. At the time of the accident the airplane had accumulated 1125.2 hours on the tachometer.

An examination of the engine revealed that the No. 4 cylinder was fracture separated from the crankcase. The piston, sections of the cylinder, and sections of the crankcase were missing. The crankshaft and remaining cylinders were intact, and the engine rotated smoothly when the propeller was turned by hand. The exhaust pushrod shroud and exhaust pushrod of the No. 4 cylinder were both bent. The No. 4 exhaust valve stem was fractured about halfway along its length. The lower half of the stem and face were missing. The No. 4 exhaust valve guide clearance was excessive, the guide and tip area of the valve contained carbon deposits. The cylinder walls contained circular gouges consistent with the exhaust valve face diameter.

The remaining section of the No. 4 exhaust valve stem was sent to the NTSB Materials Laboratory for examination. The examination revealed that the valve stem exhibited reverse bending fatigue crack propagation. In addition, high levels of lead (Pb) and bromine (Br) were present on the exhaust valve. These elements were consistent with constituents in combustion compounds derived from the tetraethyl lead additives added to avgas aviation fuel. More information can be found in the Materials Laboratory report in the docket for this case.

According to the Sky Ranch Engineering Manual, "high temperatures in the exhaust valve guide oxidizes oil and forms carbon deposits on the valve guide and these deposits" can result in a stuck valve condition. Furthermore, the "most frequent reason for elevated valve temperatures is valve leakage. All of the combustion gas must pass around the valve face as it goes out the exhaust port. A valve that is not contacting the seat properly cannot conduct as much heat into the cylinder head as a valve with good seating. Elevated valve stem temperatures may then" result in a stuck valve. Then, because of "high temperatures and combustion deposits on the exhaust valve stem, this area of the guide gets bigger. This increases the clearance between the guide and the stem and allows combustion products and heat to travel up the valve stem. These combustion products create lead deposits and acids which increase the corrosive environment."

Pilot Information

Certificate:	Private	**Age:**	51,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	May 1, 2015
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	March 27, 2017
Flight Time:	797.5 hours (Total, all aircraft), 724.9 hours (Pilot In Command, all aircraft), 26.8 hours (Last 90 days, all aircraft), 25.7 hours (Last 30 days, all aircraft), 8.8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Stinson	**Registration:**	N9366K
Model/Series:	108 2	**Aircraft Category:**	Airplane
Year of Manufacture:	1947	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	108-2366
Landing Gear Type:	Tailwheel	**Seats:**	4
Date/Type of Last Inspection:	September 16, 2016 100 hour	**Certified Max Gross Wt.:**	2231 lbs
Time Since Last Inspection:	86 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1125.2 Hrs at time of accident	**Engine Manufacturer:**	FRANKLIN
ELT:	Installed	**Engine Model/Series:**	6A4-165-B3
Registered Owner:	On file	**Rated Power:**	165 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	MJX,82 ft msl	**Distance from Accident Site:**	16 Nautical Miles
Observation Time:	20:56 Local	**Direction from Accident Site:**	1°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	19°C / 10°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	West Creek, NJ (31E)	**Type of Flight Plan Filed:**	VFR
Destination:	FREDERICK, MD (FDK)	**Type of Clearance:**	VFR
Departure Time:	20:20 Local	**Type of Airspace:**	

Airport Information

Airport:	EAGLES NEST 31E	**Runway Surface Type:**	
Airport Elevation:	38 ft msl	**Runway Surface Condition:**	Vegetation
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	Unknown
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	39.658889,-74.29972(est)

Administrative Information

Investigator In Charge (IIC):	Kemner, Heidi
Additional Participating Persons:	Gary Banas; FAA/FSDO; Philadelphia, PA
Original Publish Date:	April 4, 2019
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=95187