



National Transportation Safety Board Aviation Accident Final Report

Location:	Lodi, WI	Accident Number:	CEN16LA273
Date & Time:	07/18/2016, 1915 CDT	Registration:	N393SX
Aircraft:	BRANDT SONEX	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (partial)	Injuries:	1 None
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

During a local flight, the pilot of an experimental amateur-built airplane had a partial engine power loss. He said that the engine sounded different but remained running. He turned the airplane back to the airport and noted he was high and fast. He indicated that he bled off airspeed, as he wanted to avoid buildings before landing. He subsequently reduced power and performed a landing with calm wind present. The airplane's nose and left main landing gear collapsed after touchdown, the airplane skidded to the north side of the runway, and exited the runway into a ditch where it sustained the substantial damage. The airplane was powered by an engine that the pilot/builder assembled from a kit. The airplane accumulated 25 hours of flight time at the time of the accident. The kit manufacturer engine assembly and installation manual had specific rocker shaft instructions that included procedures on how to adjust and install rocker arms. An examination revealed that the threaded shaft of a rocker arm swivel pad had separated at a point on the shaft where there was a cross drilled hole. The remaining rocker arms did not exhibit the appearance of arm adjustment in accordance with the kit manufacturer's assembly manual. Detailed examination of the failed valve adjuster showed it separated into two portions approximately mid length in the shank area between the two threaded areas. This location was coincident with a hole drilled crosswise through the shank of the valve adjuster. The fracture surfaces exhibited crack arrest patterns consistent with a fatigue fracture. The origin of the fatigue fracture appears to be coincident with the edge of the cross-drilled hole. Examination of the exemplar valve adjuster and specifically the cross-drilled hole revealed a roughly finished surface with a pronounced burr around the circumference of the hole. A professional materials engineering publication, in part, stated, "The fatigue strength of components can be reduced merely by the presence of a drilled hole; it is further reduced by failure to remove burrs (incurred during drilling) from the hole edges. Fractures originating at drilled holes are common in complex parts containing internal, intersecting machined passages because of the difficulty and expense of providing adequate break-edge radii at such locations. It could not be determined if the failure of the rocker arm was due to the misassembly of the rocker arm assembly and/or the toolmarks left by the manufacturing process.

Probable Cause and Findings

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

The separated rocker arm assembly for undetermined reasons, which resulted in the partial loss of engine power and led to the landing gear collapsing during the subsequent forced landing.

Findings

Aircraft	Recip eng cyl section - Failure (Cause)
Personnel issues	Installation - Owner/builder
	Fabrication - Other/unknown

Factual Information

On July 18, 2016, about 1915 central daylight time, a Brandt Sonex experimental amateur-built airplane, N393SX, impacted a ditch when it exited runway 9 (1,875 feet by 105 feet, turf) at the Lodi Lakeland Airport (9WN5), near Lodi, Wisconsin, during a forced landing following a partial loss of engine power. The sport pilot was uninjured. The airplane fuselage was substantially damaged during the impact with the ditch. 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 meteorological conditions prevailed for the flight, which operated without a flight plan. The local flight originated from 9WN5 at time unknown.

The pilot reported a partial loss of engine power, which occurred northwest of 9WN5. He said that the engine sounded different but remained running. He turned the airplane back to the airport and noted he was high and fast. He indicated that he bled off airspeed, as he wanted to avoid buildings before landing. He subsequently reduced power and performed a landing. The airplane's nose and left main landing gear collapsed after touchdown, the airplane skidded to the north side of the runway, and exited the runway into a ditch where it sustained the substantial damage.

The pilot, age 71, held a Federal Aviation Administration (FAA) sport pilot certificate and he reported that he accumulated 180 hours of total flight time.

N393SX was a low-wing, fixed tricycle gear, 2-seat, experimental amateur-built airplane with serial number 393. It was powered by a 70-horsepower AeroVee engine driving a fixed pitch Sensenich propeller. The pilot reported that the airplane had a condition inspection completed on December 4, 2015, and that the airplane accumulated 25 hours of flight time at the time of the accident.

The airplane and engine were sold as kits that the owner assembled. The kit manufacturer engine assembly and installation manual had specific rocker shaft instructions that included procedures on how to adjust and install rocker arms.

At 1953, the recorded weather at the Dane County Regional Airport-Truax Field, near Madison, Wisconsin, was: Wind calm; visibility 10 statute miles; sky condition few clouds at 5,500 feet; temperature 27 degrees C; dew point 17 degrees C; altimeter 30.15 inches of mercury.

An FAA inspector examined the wreckage and observed that the threaded shaft of a rocker arm swivel pad on the rocker arm assembly had separated at a point on the shaft where there was a cross drilled hole. The accident engine's remaining rocker arm assemblies did not exhibit the appearance of arm assembly adjustment in accordance with the adjustment directions in the kit manufacturer's assembly manual. The separated rocker arm swivel pad and an exemplar pad from the accident engine were shipped to the National Transportation Safety Board (NTSB) Materials Laboratory for detailed examination.

An NTSB Materials Laboratory Engineer examined the items and produced Materials Laboratory Factual Report No. 16-101, which is appended to the docket material associated

with this investigation. The report, in part, indicated the failed valve adjuster separated into two portions approximately mid length in the shank area between the two threaded areas. This location was coincident with a hole drilled crosswise through the shank of the valve adjuster. The fracture surfaces exhibited crack arrest patterns consistent with a fatigue fracture. The origin of the fatigue fracture appears to be coincident with the edge of the cross-drilled hole. The ball bearing on the end of the valve adjuster had seized in place and could not be rotated. A measurement of the hardness on a section of the fractured valve adjuster revealed a hardness of 20.2 on the Rockwell C scale.

Examination of the exemplar valve adjuster and specifically the cross-drilled hole revealed a roughly finished surface with a pronounced burr around the circumference of the hole.

ASM International Handbook, Volume 11, Failure Analysis and Prevention, in part, stated:

The fatigue strength of components can be reduced merely by the presence of a drilled hole; it is further reduced by failure to remove burrs (incurred during drilling) from the hole edges. Fractures originating at drilled holes are common in complex parts containing internal, intersecting machined passages because of the difficulty and expense of providing adequate break-edge radii at such locations.

History of Flight

Prior to flight	Aircraft maintenance event
Enroute	Powerplant sys/comp malf/fail Loss of engine power (partial) (Defining event)
Emergency descent	Off-field or emergency landing
Landing	Collision during takeoff/land

Pilot Information

Certificate:	Sport Pilot	Age:	71, Male
Airplane Rating(s):	Single-engine Land	Seat Occupied:	Unknown
Other Aircraft Rating(s):	None	Restraint Used:	3-point
Instrument Rating(s):	None	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Sport Pilot	Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	10/30/2015
Flight Time:	(Estimated) 180 hours (Total, all aircraft), 180 hours (Pilot In Command, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	BRANDT	Registration:	N393SX
Model/Series:	SONEX	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	Yes
Airworthiness Certificate:	Experimental	Serial Number:	393
Landing Gear Type:	Unknown	Seats:	2
Date/Type of Last Inspection:	12/04/2015, Condition	Certified Max Gross Wt.:	1100 lbs
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	25 Hours at time of accident	Engine Manufacturer:	Aerovee
ELT:	C91 installed, activated, did not aid in locating accident	Engine Model/Series:	
Registered Owner:	On file	Rated Power:	70 hp
Operator:	On file	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KMSN, 866 ft msl	Distance from Accident Site:	14 Nautical Miles
Observation Time:	1953 CDT	Direction from Accident Site:	146°
Lowest Cloud Condition:	Few / 5500 ft agl	Visibility	10 Miles
Lowest Ceiling:		Visibility (RVR):	
Wind Speed/Gusts:	Calm /	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.15 inches Hg	Temperature/Dew Point:	27° C / 17° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Lodi, WI (9WN5)	Type of Flight Plan Filed:	None
Destination:	Lodi, WI (9WN5)	Type of Clearance:	None
Departure Time:	CDT	Type of Airspace:	

Airport Information

Airport:	LODI LAKELAND (9WN5)	Runway Surface Type:	Grass/turf
Airport Elevation:	844 ft	Runway Surface Condition:	Dry
Runway Used:	09	IFR Approach:	None
Runway Length/Width:	1875 ft / 105 ft	VFR Approach/Landing:	Forced Landing

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 None	Latitude, Longitude:	43.333333, -89.520833 (est)

Administrative Information

Investigator In Charge (IIC):	Edward F Malinowski	Report Date:	05/23/2017
Additional Participating Persons:	Craig Larson; Federal Aviation Administration; Milwaukee, WI		
Publish Date:	05/23/2017		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=93635		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).