Aviation Investigation Final Report

Location:	Cassville, Missouri	**Incident Number:**	CEN11IA235
Date & Time:	February 6, 2011, 11:15 Local	**Registration:**	N904MS
Aircraft:	SCHLICHTMAN STOL CH750	**Aircraft Damage:**	Minor
Defining Event:	Part(s) separation from AC	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airplane was in cruise flight when its propeller separated. The pilot performed a forced landing to a snow-covered field, during which the nose landing gear collapsed causing minor damage. Postaccident metallurgical examination of the crankshaft extension attachment bolts revealed that they had fractured from fatigue due to insufficient clamping force. Dish-shaped washers were installed between the bolt head and extension, and thread locking compound was found trapped under the concave side of the washers. The maintenance manual in effect at the time of the incident called for application of thread locking compound to both the female threads in the crankshaft and to the male bolt threads. However, this procedure has the potential for inadvertently wiping a portion of the thread locking compound that is applied to the bolt onto the face of the propeller extension without the installer knowing, thereby trapping it between the washer and the extension face. In this incident, the torque applied to the attachment bolts at installation was insufficient to squeeze out the thread locking compound from under the washers and compress the washers flat, which would have produced the proper metal-to-metal contact. While the applied torque may have been less than specified, it is also possible that the trapped thread locking compound may have had a hydraulic effect that resisted the clamping force associated with a properly applied torque. In the former case, insufficient clamping force would have been present from the time of installation. In the latter case, clamping force could have lessened over time due to wear at the edges of the washer, compression creep, and wear of the trapped thread locking compound. Since this event, the manufacturer has implemented changes to the maintenance procedures with detailed instructions and warnings to prevent contamination of the crankshaft, propeller hub extension, washers, and bolt faces with thread locking compound. In addition, the design of the hub attachment has been modified to incorporate three 8 millimeter dowel pins between the hub and crankshaft to prevent movement between the propeller extension and crankshaft.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The fatigue failure of the propeller hub retaining bolts due to insufficient clamping force .

Findings

Aircraft	Propeller hub section - Fatigue/wear/corrosion
Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Enroute-cruise	Part(s) separation from AC (Defining event)
Emergency descent	Off-field or emergency landing
Landing-landing roll	Landing gear collapse

On February 6, 2011, about 1115 central standard time, an amateur built Zenith STOL CH750, N904MS, experienced a separation of the propeller during flight near Cassville, Missouri. The pilot executed a forced landing to a snow covered field and the nose landing gear collapsed resulting in minor damage. The pilot and passenger were not injured. The airplane was owned and operated by a private pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed and no flight plan was filed. The local flight originated from the Cassville Municipal Airport, Cassville, Missouri, about 1105.

The airplane was powered by a Jabiru Model 3300 reciprocating engine rated to produce 125 horsepower. The propeller hub/extension was not integral to the engine crankshaft and was a separate piece bolted to the crankshaft using six high strength bolts. The separated propeller was recovered subsequent to the event. The propeller remained attached to a propeller hub/extension, which was separated from the crankshaft. The six hub retention bolts had failed. The recovered pieces included the hub/extension, and the failed bolts were subsequently retained for examination.

The National Transportation Safety Board Materials Laboratory examined the components and determined that the six bolts used to attach the propeller hub/extension to the crankshaft had failed and had fracture features consistent with fatigue. Further examination revealed fretting on the mating surfaces between the crankshaft and propeller hub extension. The washers between the retaining bolt heads and the forward surface of the propeller hub extension exhibited a dished shape. Three of the washers had the concave side of the washer installed facing the hub and a fourth washer was installed with the concave side facing the bolt head. The remaining two washers were not removed from the hub during the examination. The retaining bolt threads had a coating of a stiff green material consistent with thread locking compound. The aft faces of the retaining bolt washers had areas with the same material on them. A portion of the material was lifted from one of the washers and the thickness measured at 0.0016 inches.

The propeller was a multi-piece ground adjustable design with composite blades and an aluminum alloy hub. Disassembly of the propeller revealed that the bolts used to mount the aft half of the hub to the engine propeller flange were installed with the bolt shank facing forward. This installation is contrary to the written guidance provided by the propeller manufacturer and resulted in localized damage to the blade roots where the protruding bolt shank impinged on the blade root. The damage did not extend beyond the immediate area of the impingement. Interviews with the pilot indicate that the propeller operated normally with no excessive vibration until separation.

The engine manufacturer provided information relating to 6 previous events of hub/extension separation from the same or similar model engines as follows:

1 - The first event was a Jabiru 5100 series engine that experienced a hub/extension separation in the United Kingdom. The engine manufacturer attributed the separation to use of incorrect length hub/extension bolts.

2 – A Jabiru 2200 engine in Ireland experienced a hub/extension separation. The engine manufacturer attributed the separation to use of an unauthorized propeller.

3 – A Jabiru 2200 engine in the United Kingdom experienced a propeller hub/extension separation. The engine manufacturer attributed the separation to use of an unauthorized propeller.

4 – A Jabiru 2200 engine in Australia experienced a propeller hub/extension separation. The engine manufacturer attributed the separation to improper torque of the 6 attachment bolts.

5 – A Jabiru 2200 engine in the United States experienced a propeller hub/extension separation. The engine manufacturer attributed the separation to the prior use of an unapproved propeller type. At the time of the separation the engine was fitted with an approved propeller.

6 – A Jabiru 3300 engine in the United States experienced a propeller hub/extension separation. Details of the cause of this event were not provided.

The maintenance manual that was in effect at the time of the incident described applying thread locking compound to both the female threads in the crankshaft and to the male bolt threads. The engine manufacturer has instituted changes to the maintenance manual regarding the use of thread locking compound on the propeller hub extension. The revised manual contains detailed instructions and warnings to prevent contamination of the crankshaft, propeller hub extension, washers, and bolt faces with thread locking compound. In addition, the design of the hub attachment has been modified to incorporate three 8 millimeter dowel pins between the hub and crankshaft to prevent movement between the propeller extension and crankshaft.

Pilot Information

Certificate:	Private	**Age:**	47
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	June 2, 2010
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 8, 2010
Flight Time:	1572 hours (Total, all aircraft), 125 hours (Total, this make and model), 1460 hours (Pilot In Command, all aircraft), 25 hours (Last 90 days, all aircraft), 5 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	SCHLICHTMAN	**Registration:**	N904MS
Model/Series:	STOL CH750	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	75-7495
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	March 3, 2012 Condition	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	90 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	125 Hrs at time of accident	**Engine Manufacturer:**	Jabiru
ELT:		**Engine Model/Series:**	3300
Registered Owner:	On file	**Rated Power:**	125 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:	HFJ,1313 ft msl	**Distance from Accident Site:**	14 Nautical Miles
Observation Time:	17:15 Local	**Direction from Accident Site:**	315°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 1800 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.9 inches Hg	**Temperature/Dew Point:**	3°C / -1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Cassville, MO (94K)	**Type of Flight Plan Filed:**	None
Destination:	Cassville, MO (94K)	**Type of Clearance:**	None
Departure Time:	11:05 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Minor
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	36.670829,-93.860504(est)

Administrative Information

Investigator In Charge (IIC):	Brannen, John
Additional Participating Persons:	Tom Bartells; Kansas City FSDO; Kansas City, MO
Original Publish Date:	February 3, 2014
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=78576