SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-40

AIRCRAFT ACCIDENT SHORT REPORT

CA18/2/3/9793: A propeller blade separated in-flight, followed by an unsuccessful forced landing on a dirt road.

Date and time	:	8 June 2019 0946Z
Aircraft registration	:	ZU-LSA
Aircraft manufacturer and model	:	Czech Aircraft Works Spol SRO
Last point of departure	:	Bethlehem (FABM) Aerodrome
Next point of intended landing	:	Bethlehem (FABM) Aerodrome
Location of incident site with reference to easily defined geographical points (GPS readings if possible)	:	S27°56'35.74" E28°17'.14.76" at an elevation of 5 561 ft AMSL
Meteorological information	:	Temperature: 21°C, Visibility: 10km
Type of operation	:	Part 94
Persons on-board	:	1 + 1
Injuries	:	None
Damage to aircraft	:	The aircraft was substantially damaged

All times given in this report is Coordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or liability.***

Disclaimer

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Figure 1*:* A photograph of the aircraft.

Publication date: 10 June 2021

1. SYNOPSIS

1.1 On Saturday 8 June 2019, the pilot and a passenger on-board the aircraft with registration ZU-LSA took off from Bethlehem (FABM) Aerodrome with the intention to participate in a speed rally competition in the Bethlehem area. Visual Meteorological Conditions (VMC) prevailed in the area and the aircraft was operated at 6500 feet (ft) above mean sea level (AMSL), following the set rules by competition organisers, Bethlehem Aero Club. According to the pilot's report, approximately 60 minutes into the flight whilst the aircraft was cruising at 105 knots indicated airspeed, he felt a severe vibration on the propeller, followed by one blade (blade C) separating from the aircraft. He instantly switched off the engine and altered the aircraft pitch so he could glide it whilst looking for a suitable place to execute a forced landing. During the landing roll, the aircraft impacted a wooden fence pole with its right wing and spun around. It eventually came to a stop facing the opposite direction. The pilot and the passenger sustained no injuries; the aircraft sustained substantial damage. Post-accident investigation on the propeller indicated a failure on blade C aluminium sleeve.

1.2 The investigation revealed that the failure of blade C aluminium sleeve occurred due to lack of maintenance which caused all three blades not to operate in a synchronised movement. Due to centrifugal/aerodynamic forces acting on the blades, it (the blade) started to vibrate, causing an initiation of a crack on the blade C sleeve, which increased overtime before separating in-flight.

2. FACTUAL INFORMATION

2.1 HISTORY OF FLIGHT

2.1.1 On Saturday morning 8 June 2019, the pilot accompanied by a passenger took off from Bethlehem (FABM) Aerodrome in a Sportscruiser X320 aircraft with the intention to participate in a speed rally competition. Visual meteorological conditions (VMC) prevailed in Bethlehem area at the time; the pilot also reported fine weather conditions in the area at the time of the flight. The aircraft was operated at 6500 feet (ft) following the set rules by competition organisers, Bethlehem Aero Club. Approximately 60 minutes into the flight whilst the aircraft was cruising at 105 knots (kt) indicated airspeed (IAS), the pilot felt a severe vibration in the propeller.

2.1.2 The pilot attempted to identify the cause of the vibration, going through various checklist procedures, but the vibration continued. Initially, there were no adverse indications on the engine instruments. In less than five seconds after completing going through the checklist, one blade separated from the aircraft and the pilot switched off the engine. After the propeller had stopped rotating, the pilot altered the aircraft pitch so he could glide it whilst looking for a suitable place to perform a forced landing. He spotted a narrow dirt road and, during the landing roll, the aircraft impacted a wooden fence pole

with its right wing and spun around. It eventually came to a stop facing the opposite direction. The landing gear collapsed during the landing roll and the engine carburettors detached from the aircraft. The remaining two blades broke, and the route grip on blade B root failed during the accident sequence. The aircraft sustained substantial damage, however, no person was injured.

2.1.3 The aircraft was recovered to the Krugersdorp (FAKR) Aerodrome where it was examined. The aircraft was operated under the provisions of Part 94 of the Civil Aviation Regulations as amended in 2011.

2.1.4 The accident occurred during daylight at a geographical position determined to be S27°56'35.74" E28°17'.14.76" at an elevation of 5 561 feet (ft) AMSL.

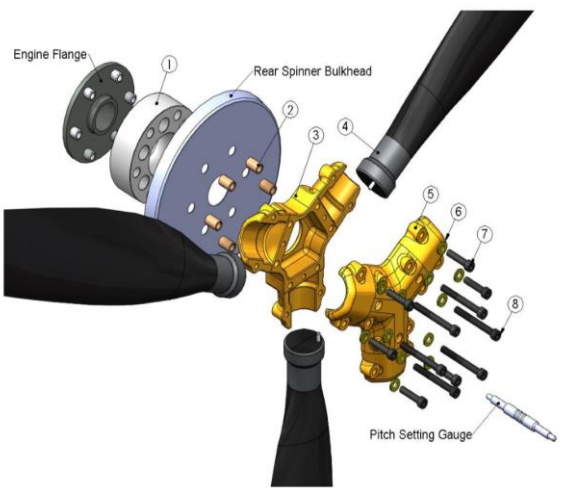
Figure 2: The Sportscruiser X320 at the accident site. (Picture courtesy of the aircraft owner)

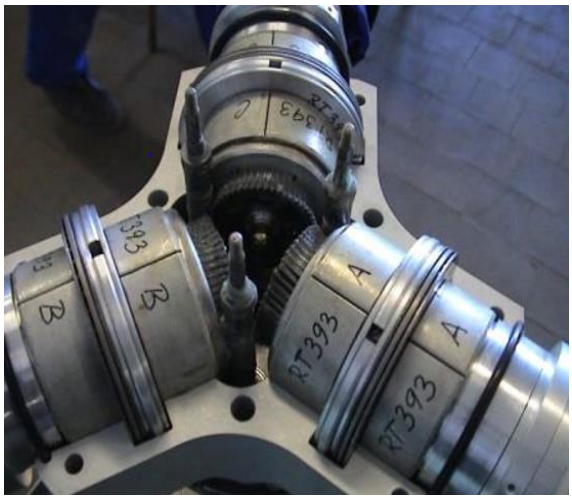
3 Post-accident examination and investigation:

3.1. The aircraft had a Woodcomp, three-bladed electric variable pitch propeller−SR 3000/3, serial number (S/n), RT436 fitted to it. The propeller was manufactured on 24 April 2006. This propeller was mounted on the engine propeller flange using 6 M8 bolts, which protrude from the rear of the propeller with pain washers and self-locking nuts tightened to a torque of 22 Newton Metre (Nm). The propeller blades are mounted within the hub sockets, the shank of a blade is mounted within a hub socket on bearings – plain bearing; needle roller thrust bearing with an inner and outer plain race – which constrain the propeller blade against outward movement while under influence of centrifugal force due to rotation of the hub.

3.2 The bearings also enable the blade to be turned on its axis and pitch change to be, thereby, enabled. The blade pitch angle on this propeller was set using an eccentric pin installed at the bottom of the sleeve. During a normal flight, the blades are set to give a fine pitch limit of 18º and a course pitch limit of 28º. The pitch limit control operates in such a manner that the end stop cam, situated on the blade, contracts and opens the electrical microswitch, and the blade then stops at the pre-set angle. If it is over-ridden, the machine cut out in the blade stops against a dowel in the hub. The critical outer

section of the blade leading edge is protected, optionally, by wear-resistant cast polyurethane or stainless steel. The inner section of the leading edge is protected by a self-adhesive polyurethane (PU) protective tape. Both contribute to the operability of the propeller in difficult climatic conditions. The single piece propeller hub is made of forged high-quality corrosion-resistant aluminium alloy. The balancing weights are installed onto the spinner backplate. The wooden core is strengthened and protected by layers of composite with glass, carbon or aramid fibre reinforcement. The blade root is connected to the aluminium sleeve using special screws (see Figure 8).



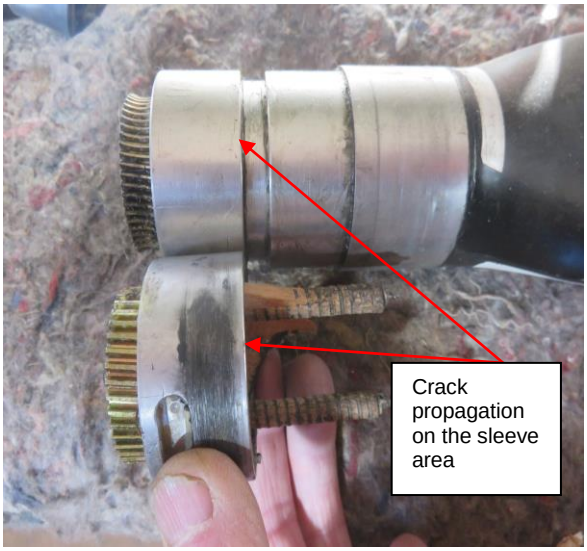


Figures 3&4: The design of the propeller and how the blades are fitted into the hub.

3.3 The propeller was removed from the wreckage on 13 June 2019 and transported to Brits (FABS) Airfield for teardown inspection by Woodcomp certified agent, Aircraft Maintenance Organisation (AMO) 969 under the auspices of the investigator-in-charge (IIC). Visual inspection on the hub area indicated nothing abnormal. No evidence of grease leak or any form of damage was observed. The electrical motor for the electrical variable pitch propeller was tested and found to operate in both directions. The propeller hub was dismantled, and all components were examined. Each of the propeller blade and their corresponding aluminium blades sleeves were labelled A, B and C for identification purposes. Visual examination on the hub area also showed that grease had dried out on all components, including the main bearing. However, no signs of internal corrosion, chafing, deterioration and cracks were observed. The mechanical pitch stops were all close to the mechanical fine stop set at 12.5º but not touching.

3.4 The adjustment mechanism and all the components were in a relatively good condition. Blade A and B consisted of an entire sleeve and a small amount of fractured wood inside the sleeve, however, the sleeve on blade C had fractured at the position where the blade has a gap where it holds the main bearing. Blade C separated, exposing the special screws and the O-ring shaft seal that prevents the lubricant leak from the main bearings. See Figures 5-8.

Figures 5 & 6: On the left is a dismantled propeller hub with some of the bearings visible, and on the right are the main bearings.



Figures 7 & 8: On the left is a picture of blade C showing the aluminium sleeve area where the failure occurred. On the right are special screws and the O-ring shaft seal.

3.5 The Woodcomp Service Bulletin (SB) – No UL02/2012 EN, Rev. C dated 8 November 2012 requires that the propeller overhaul intervals be conducted after 300 operating hours or every five years, whichever occurs first. The reason for this is that the propeller is subjected to centrifugal and aerodynamic forces each time it is operated; it is also subjected to vibration load caused by the propeller's own vibration and the vibration induced by the engine. The SB stated above was not complied with.

3.6 Post-accident examination of the aircraft records showed that when the propeller in question was procured by the previous aircraft owner around 2014, it did not have a documented history of regular inspection or overhaul since new (OSN). Due to its unknown history, it was sent for overhaul at the local certified service centre in FABS on 30 May 2014, from which job card−No 598/2014 was raised. The propeller logbook was rectified, and the operating hours were re-started at zero (0) hour from the time of overhaul. The propeller was later fitted to the ZU-LSA aircraft by an approved person (AP)

No 026 on 2 June 2014. The propeller remained on ZU-LSA until the aircraft was sold to the current owner. Examination of the aircraft logbooks showed that the most recent annual inspection was conducted and signed out on 10 November 2018 by AP 073 at 446.0 total airframe hours. The aircraft had accumulated a total of 484.1 hours at the time of the accident, total engine hours since new were 481.1 and the propeller, since overhaul, had 476 total time. The aircraft had accumulated a total of 38.1 hours since its last annual inspection. Further scrutiny into the aircraft logbooks showed no evidence of the propeller being overhauled since 30 May 2014. Records showed that the blades were only dressed and repainted each time an annual inspection was conducted. The propeller manufacturer was consulted, and they indicated that the propeller was never sent to them for overhaul or for any form of inspection. According to the service letter-2016-12 issued by the Woodcomp on 30 November 2016, all SR116, SR200, SR3000 and SR3000 propeller blades life limit is 10 years from the date of production. Experience and results from tests performed by Woodcomp testing department showed that propellers, after a 10-year life term, are often in good conditions and a decision to extend the service life time of the above-mentioned propellers was permitted only under the conditions listed below as outlined in the service letter:

- *Provable documented operating hours of the propeller – propeller blades:*
- *Blade damage from operation must not exceed the permitted tolerance specified in maintenance documentation of related propeller:*
- *Fluorescent dye-penetrant inspection of the blade ferrule on-destruction inspection must be performed in accordance with standard practice for liquid penetrant testing (ASTM) E-1417 using liquid penetrant type I with a Level 4 Ultra High Sensitivity and during the examination cannot be found any inadmissible indication:*

3.7 The number of years of the propeller in operation could not be determined due to lack of appropriate historical documentation.

3.8 Post-accident investigation and teardown inspection of the propeller uncovered a failure on blade C aluminium sleeve. What caused this blade to separate was the in-flight propagation of a fatigue crack in the blade sleeve that had been visually covered up by non-compliance to the manufacturer's service instructions. The failure emanated from fatigue caused by vibration stresses.

4. CONCLUSION

4.1 Findings

4.1.1 Fine weather conditions prevailed at the time of flight and this was considered not to have a bearing on the accident.

4.1.2 The flight was conducted under the provisions of Part 94 of the Civil Aviation Regulations 2-11 as amended.

4.1.3 The pilot held an aviation medical certificate issued on 26 February 2019 and valid until 28 February 2022. The pilot had a restriction to wear suitable corrective lenses.

4.1.4 The pilot held a National Pilot Licence (NPL) issued on 1 June 2007 with an expiry date of 17 February 2020. The pilot's skills test was conducted on 18 February 2018.

4.1.5 The PF had accrued 150.4 total flight time on aircraft type and had 661.5 total flight time.

4.1.6 The aircraft's Certificate of Registration was issued on 14 October 2014.

4.1.7 The aircraft's Authority to Fly (ATF) was issued on 14 November 2018 with an expiry date of 9 November 2019. One of the limitations under which the ATF was issued was that all flights shall be conducted under visual meteorological conditions (VMC) by day only.

4.1.8 Review of aircraft maintenance records showed that the aircraft's most recent annual inspection was completed and signed out on 10 November 2018 at 446.0 total hours.

4.1.9 The aircraft had accumulated a total of 484.1 hours at the time of accident, total engine hours since new were 481.1 and the propeller, since overhaul in 2014, had 476 total hours, and had overflown by 176 hours. The aircraft had accumulated 38.1 hours since its last annual inspection.

4.1.10 The investigation revealed that the maintenance interval was significantly exceeded and that there was non-adherence to the requirements of the propeller manufacturer.

4.1.11 The aircraft had about 110 litres of unleaded fuel at take-off.

4.1.12 The aircraft lost one propeller blade in-flight. On examining the propeller during teardown inspection, it was established that the aluminium sleeve on blade C had fractured due to vibration and the blade had separated from the hub, exposing the special screws and the O-ring. The blade broke off at a position where the blade has a gap where it holds the main bearing. This resulted in an unsuccessful forced landing.

5. PROBABLE CAUSE/S:

5.1 The failure of blade C aluminium sleeve was due to lack of maintenance which caused all three blades not to operate in a synchronised movement. Due to centrifugal/aerodynamic forces acting on the blades, it (the blades) started to vibrate, causing an initiation of a crack on blade C sleeve which increased overtime, before separating in-flight. The failure resulted in an unsuccessful forced landing.

6. SAFETY MESSAGE:

6.1 None.

This report is issued by:

Accident and Incident Investigations Division

South African Civil Aviation Authority

Republic of South Africa