SERIOUS INCIDENT

Aircraft Type and Registration:	Sportstar Max, G-TMAX	
No & Type of Engines:	1 Rotax 912ULS2 piston engine	
Year of Manufacture:	2010 (Serial no: 2010 1305)	
Date & Time (UTC):	25 May 2020 at 1340 hrs	
Location:	White Ox Mead Farm Airstrip, near Bath, Somerset	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Propeller damaged	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	73 years	
Commander's Flying Experience:	287 hours (of which 120 were on type) Last 90 days - 5 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot, and further enquiries by the AAIB	

Synopsis

A propeller blade detached from the propeller hub during the initial climb out, causing a high level of vibration and the engine to stop. The pilot made a successful forced landing in a field. The detached blade was not recovered, and the cause of the failure was not identified.

History of the flight

The aircraft departed from Runway 20 at White Ox Mead Airstrip in fine weather conditions. Towards the end of the takeoff run the pilot reported feeling a distinct high-frequency vibration, but as he was beyond the point on the runway where the aircraft could safely be stopped, he continued with the takeoff. The vibration continued as the aircraft became airborne so the pilot reduced power and started a left turn, with the intention of returning to the airstrip if the vibration continued. As the aircraft climbed through 250 ft agl the vibration increased and the pilot reported hearing a loud bang and observed a propeller blade passing over the canopy. The vibration increased significantly after the propeller blade detached, causing the forward-hinged canopy to open and be sucked upwards into the airflow. The engine also stopped, which the pilot subsequently determined was due to the carburettors detaching from the inlet manifolds.

At approximately 200 ft agl the pilot selected a crop field, which was into wind and had an upslope, and made a successful forced landing (Figure 1). No additional damage was

incurred during the landing. Despite a search of the area that the aircraft had overflown, the detached propeller blade was not located.

Figure 1

G-TMAX following the propeller blade detachment (missing blade position circled in red)

Aircraft information

The aircraft was fitted with a three-bladed Woodcomp Klassic 170/3/R propeller and the blades were numbered 1, 2 and 3, with Blade 2 being the blade which failed in flight. The propeller blades are moulded from carbon and glass fibres embedded in a polymer matrix and are clamped between two aluminium alloy half-hubs to form the propeller assembly (Figure 2). The blade pitch may be adjusted by rotating the blade roots within the hub, when the hub screws are suitably loosened. The propeller is attached to the engine reduction gearbox drive flange by six bolts.

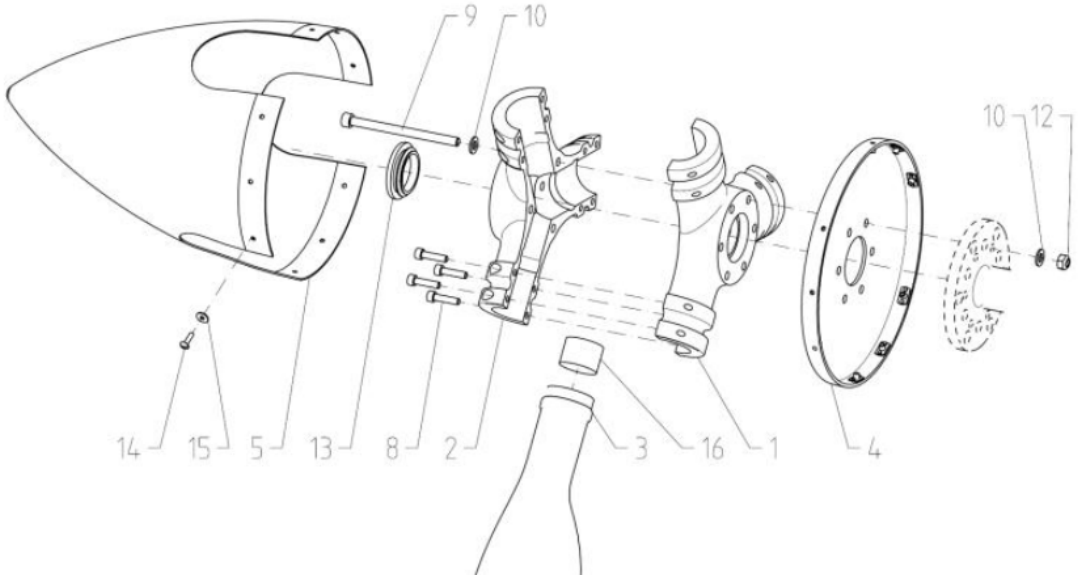

Figure 2

Propeller assembly (courtesy Woodcomp)

The propeller, when new, was installed on the aircraft in 2017 and had accumulated 215 hours when it was then removed following a propeller strike in August 2018. The propeller was overhauled by the manufacturer and was reinstalled on the aircraft in July 2019. The propeller accumulated a further 80 hours and the aircraft owners stated that they had not experienced any abnormal vibration when flying the aircraft prior to the incident. They were also not aware of any pre-existing damage to the propeller.

Propeller examination

The propeller was removed from the engine by an engineer and no abnormalities were noted with the attachment bolts. The propeller was disassembled by the AAIB for an initial examination, and the components were then sent to the manufacturer for a further examination.

AAIB initial examination

The hub screw torques were checked by unscrewing the screws with a calibrated torque wrench. Three of the 12 hub screws were found to be marginally below the required torque value of 10 Nm, with the lowest screw torque measured at 7 Nm. The other screw torque values were in the range 10-14 Nm. It is possible that the vibration experienced in the incident may have loosened the screws that were found below the prescribed torque figure.

The propeller blade pitch angles of the remaining two blades (Blades 1 and 3) were measured in accordance with the procedure in the Propeller User Manual. The results showed pitch angles of 18.9° for Blade 1 and 19.3° for Blade 3.

Examination of the internal faces of the hub bores showed only normal contact marks made from the clamping of the propeller blade roots, and no visible evidence of rotation of the blade roots within the hub. The clearance between the hub halves when assembled was also within prescribed limits.

Visual examination of the retained root section of Blade 2 showed that it had failed by overload in forward bending, in the propeller thrust direction, in combination with the propeller centrifugal loading (Figure 3). There was no evidence of dirt or contamination on the fracture surfaces that might be present had progressive cracking occurred over a number of flights.

Cracks were evident in the trailing edge root section of Blade 3, and the leading edge root section of Blade 1 (Figure 4). It is likely that these cracks were the result of the high propeller vibration experienced following the release of Blade 2. A leading edge crack was also evident at approximately mid-span on Blade 3. This may have been caused by the excessive propeller vibration, or alternatively could have been caused by contact with Blade 2 following its release (Blade 3 follows Blade 2 in the rotation sequence).

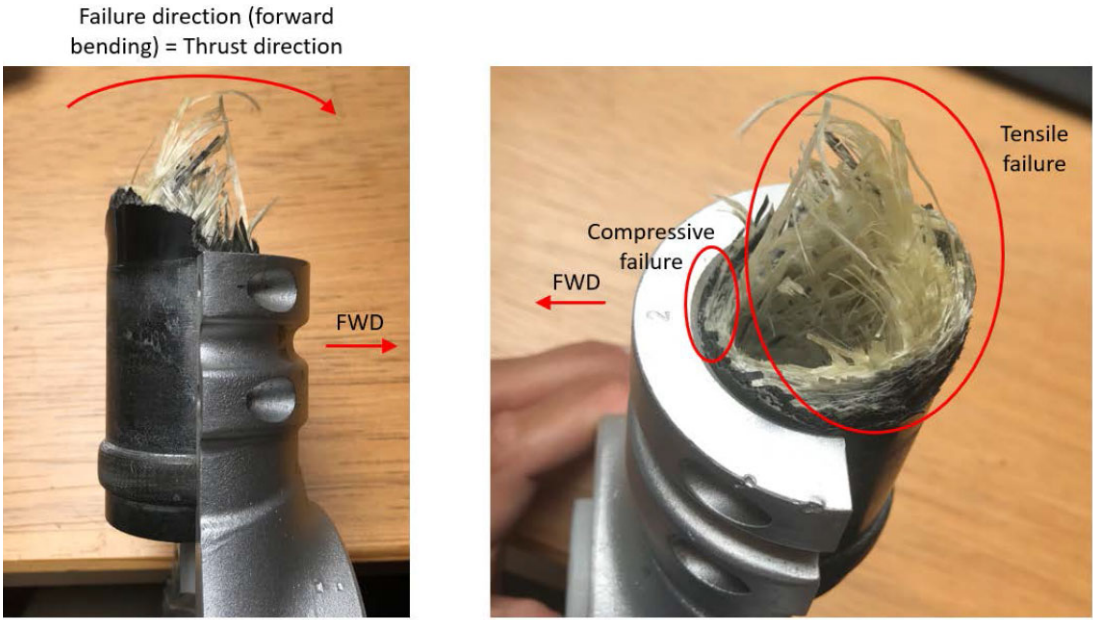

Figure 3

Blade 2 fracture surfaces

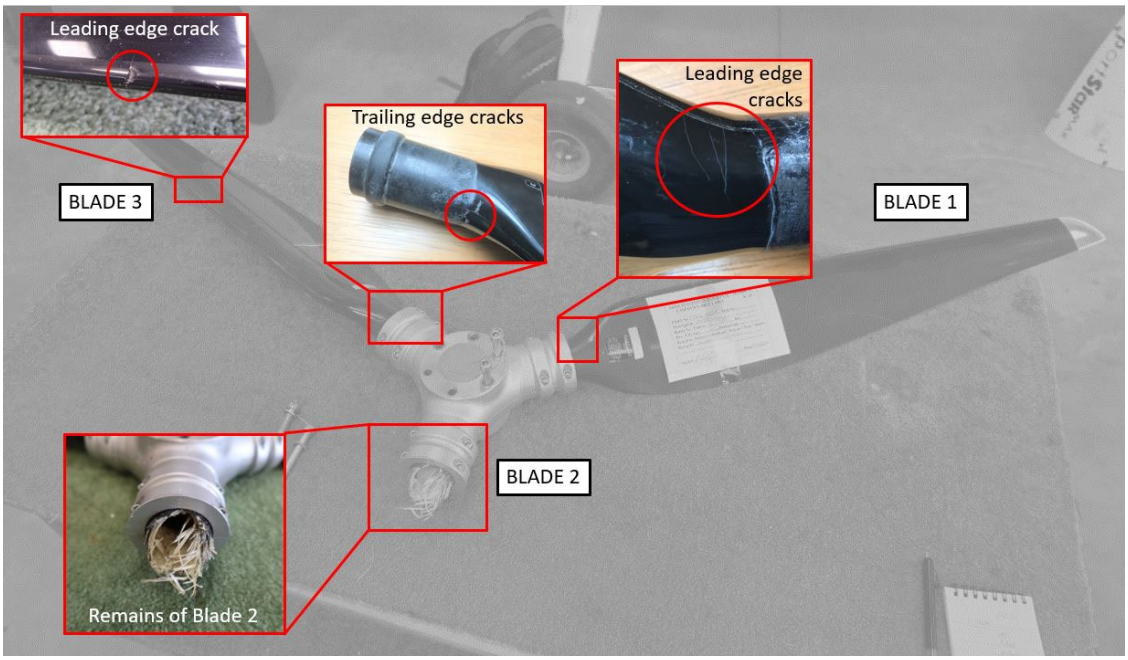

Figure 4

Propeller damage observations

Manufacturer's examination

The manufacturer noted that the failure appeared to be similar to previous blade releases that had occurred following a propeller strike with the ground or a foreign object. They also observed that the outer surface of the root section of Blade 2 did not show any evidence of visible changes in the polymer matrix, such as whitening or small cracks, that would indicate a progressive failure.

Analysis

The propeller blade detached under the combination of centrifugal and thrust loads during normal operation in the initial climb out from White Ox Mead Airstrip. The absence of any evidence of progressive cracking prior to the blade's release indicates that the propeller was weakened prior to the failure, possibly due to contact with the ground or a foreign object. The increasing level of vibration experienced during the latter stages of the takeoff roll is consistent with a change in the stiffness or mass of a propeller blade during the takeoff roll. As the released blade was not recovered, it was not possible to identify the cause of the failure.