ACCIDENT

Aircraft Type and Registration:	Schempp-Hirth Duo Discus T, G-SAXT	
No & Type of Engines:	1 - Solo 2350D self-sustaining piston engine	
Year of Manufacture:	2007 (Serial no: 158)	
Date & Time (UTC):	6 September 2015 at 1437 hrs	
Location:	Droxford, Hampshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to propeller and fuselage	
Commander's Licence:	BGA Gliding Certificate	
Commander's Age:	54 years	
Commander's Flying Experience:	2,500 hours (of which 300 were on type) Last 90 days - 58 hours Last 28 days - 30 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot of the glider deployed the self-sustaining engine in preparation for crossing a stretch of water but, after about five minutes running, there was a bang followed by severe vibration as the propeller shed one of its five blades. He also sensed a restriction in aileron movement, so decided to force-land in a field, which he carried out successfully without further incident or damage.

It was found that two segments of the propeller hub had failed and caused release of the blade, which had embedded itself in the left wing root. Subsequent examination found that the failures were due to metal fatigue cracking, a known problem with this model of propeller.

History of the flight

It was intended to fly the aircraft from RAF Halton to Bembridge on the Isle of Wight and return. The engine was deployed and tested shortly after takeoff and the flight continued, unpowered, to the region of Lee-on-the-Solent without incident. Because the soaring conditions were poor, the engine was started at a height of 2,500 ft in preparation for crossing the Solent. However, after about 5 minutes and at a height of 3,000 ft, there was a loud 'bang' and substantial vibration was felt.

The ignition was turned off and, when the propeller had stopped, the pilot and passenger (also a pilot) could see that it was missing a blade. The handling pilot transferred control to

the other pilot for a short period whilst he gathered up loose items, such as GPS navigation equipment, which had been thrown around the cockpit during the incident. When he returned his hands to the controls, he felt a restriction in aileron movement, so he looked straight ahead for a suitable field requiring minimal aileron input. He saw a suitable stubble field about 10-12 km away, which was also into-wind. He stowed the engine and landed in the field without further damage or incident.

Aircraft description

The Duo Discus is a two-seat glider; the 'T' denotes that it is fitted with a self-sustaining retractable engine which is intended to maintain, or slightly increase, altitude when required.

The engine fitted is a small, two-cylinder, two-stroke petrol engine driving a five-bladed folding propeller. When stowed, the engine and its mounting mast lie horizontally inside the fuselage in a hatch behind the cockpit, with the propeller blades folded forwards. When the pilot deploys the engine, the hatch doors open and the mast and engine are electrically extended – the propeller blades unfold on being exposed to the slipstream. The pilot must then decompress the engine, place the aircraft into a shallow dive and, when the windmilling propeller reaches a set rpm, the engine compression is restored and the engine should start. It will then run up to its rated power (the pilot cannot vary the power demand, he can only switch the engine off).

The propeller has five composite blades mounted on an aluminium alloy hub (Figure 1). The blades are of different lengths and the 'blocks' in which they are mounted on the hub are also different sizes.

Aircraft examination

Apart from the detached propeller blade, which had embedded itself in the left wing root causing damage to the aileron control circuit in that area, the adjacent blade had been badly damaged, apparently due to being struck by the departing blade. It was immediately apparent that the blade had detached due to failure of the metal hub blocks which locate it (Figures 1 and 2).

When examined by the AAIB, the detached blade had been removed from the fuselage/wing root, but there were also several small marks on the fuselage and wing where debris had impacted. There had also been damage caused by the engine moving on its flexible mounts under the severe out-of-balance forces which had been generated.

Figure 1

Photograph of propeller showing detached blade and damage to adjacent blade

The propeller was removed and sent to a materials laboratory for detailed examination. The metallurgical report states that the blade had detached due to pre-existing fatigue cracking of the metal hub blocks which retain it (Figure 2).

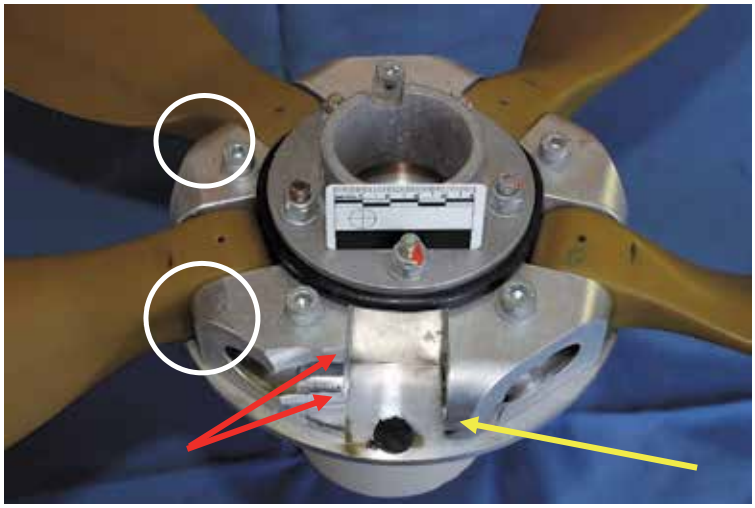

Figure 2

Photograph showing fractured hub blocks.
Yellow arrow points to the initial crack origin and double red arrows point to secondary cracking resulting from released section of right-hand block.
Additional cracks were found at the locations circled

Analysis of the fracture showed that the first crack to appear had originated on the outside of the block at the location arrowed in Figure 2. This then propagated inwards towards the blade trunnion bore. As this crack lengthened, the stresses created another crack at right angles propagating rearwards and eventually releasing a quarter-circular arc of the block. The out-of-plane loads this generated caused two more cracks to grow outwards from the bore of the other block until another, larger, section of metal broke off and the blade was released.

Cracks were also noted in the block retaining the trunnion for two other blades. Breaking these open confirmed that they were also fatigue cracks. The cracks were consistent with high frequency oscillations and did not appear to be associated with material defects.

Previous occurrences and safety actions

The subject propeller, with the part number FL5.110/83AV, was made by a German company called Technoflug. At the time of failure it had logged 36.8 flight hours.

The problem of hub cracking appears to have been recognised by the glider manufacturer at least as far back as 2006, when they issued a 'Technical Note' No. 890-8/868-11 in September of that year. The Technical Note required owners of aircraft up to Manufacturer's Serial Number 149 (later raised to MSN 174 in November 2012, when TN 890-13 was issued) to perform the following actions:

ACTION 1: *Visual check of the propeller hub:*

In the area of the five propeller blade roots the propeller hub has to be checked for cracks. If necessary the hub has to be cleaned before.

ACTION 2: *Inspection and revision of the propeller hub:*

For inspection and revision of the propeller hub the propeller has to be removed. Together with a declaration about the operating time it has to be sent to the manufacturer of the propeller:

Technoflug Leichtflugzeugbau GmbH
Dr. Kurt Steim Straf3e 6
D-78713 Schramberg

ACTION 1 was to be performed on all propellers before further flight. ACTION 2 was to be done at the next annual inspection for propellers with fewer than 15 hours of operation; those with more than 15 operating hours were to perform the action before further flight.

Although the Technical Note requirements were not repetitive, in November 2011 the manufacturer's Flight Manual for the Duo Discus T was amended to include the following inspection as part of the Daily Inspection routine:

Check propeller hub and propeller blades for cracks or other damage, in particular also the area near the blade bearing marked in the following picture:

The BGA and the UK agent for Schempp-Hirth estimates that there are about 47 self-sustaining gliders in the UK which use the same type of propeller. Of these, cracks have been found in about six units. Owners of propellers found to have cracked hubs, and which have been returned to the manufacturer for repair, have found that they have been returned with a new design of hub (identifiable by the fact that all the hub blocks are of equal size). Informal inquiries by the AAIB suggest that no instance of cracking has been found with the later standard of hub, which has been available as a new or exchange item since the end of 2013.