ACCIDENT

Aircraft Type and Registration:	Silence Twister, G-TWST
No & Type of Engines:	1 Jabiru 2200A piston engine
Category:	1.3
Year of Manufacture:	2004
Date & Time (UTC):	27 February 2005 at 1256 hrs
Location:	Aylesbury (Thame) Airfield, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Landing gear collapsed, engine and front cowling detached, broken propeller blades, damage to aircraft underside
Commander's Licence:	Private Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	420 hours (of which 5 were on type) Last 90 days - 5 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

History of the flight

The newly built aircraft was on a local test flight out of Wycombe Air Park and this was its second flight of the day and its seventh flight overall. It was cruising at approximately 4,000 ft amsl over the Oxford Plain near Thame, when the engine started to run roughly and reduce in power. The pilot selected the carburettor heat on and decided to remain in the vicinity of Aylesbury (Thame) Airfield as a precautionary measure. He then turned the electric fuel pump on, switched fuel tanks, reduced the power setting and changed magnetos but none of these actions remedied the engine problem. The engine was producing only sufficient power for the aircraft to maintain level flight or climb very slowly. He then informed Wycombe ATC by radio that he had a suspected carburettor icing problem and was planning on carrying out a precautionary landing at Aylesbury Airfield. The pilot carried out a high approach to Runway 06 using full flap and the aircraft landed two-thirds of the way down the 1,000 m grass runway. He then taxied back to the downwind end of the runway during which time the cylinder head temperature rose (as is normal) and the engine seemed to clear. The pilot then shut down the engine to carry out some checks. He visually inspected the fuel tanks and found that the right tank was

approximately two thirds full and the left tank was one third full. He then checked the engine air intake, checked the carburettor heat mechanism, and drained a fuel sample from both wing tanks and from the gascolator. The fuel samples were clear of contamination. The pilot believed that the engine had either been suffering from carburettor ice and that the carburettor heat was not sufficient to clear it, or the fuel had been contaminated. He started the engine again, checked both magnetos at idle, and then made an extended full power run before reducing to 75% power and then idle. The engine ran normally with no indication of the earlier rough running. Consequently, the pilot then switched tanks, turned the electric fuel pump on, selected 10º of flap, and carried out a short field takeoff.

The aircraft climbed normally and then at a height of 400 to 500 ft agl the engine started to run roughly again. Because there was insufficient runway remaining to land straight ahead and because he expected to be able to maintain height, he levelled off and turned left to carry out a short circuit. Once the aircraft was established on the downwind leg the engine ceased producing power. The pilot estimated his tailwind to be 10 to 15 kt but he did not think he had sufficient height to turn back into wind so he decided to land downwind on a recently ploughed rough field. He did not have time to retract the landing gear so when the main wheels hit the ground the aircraft nosed over onto the propeller. The landing gear collapsed and the fuselage-to-engine mount fittings failed, causing the engine to separate. The remainder of the aircraft continued over the engine and came to rest erect. The pilot immediately turned off the ignition and switched the fuel to SHUT OFF. There was no fire and he was experiencing back pain so he remained seated for a few minutes.

A pilot flying a Robinson R44 helicopter saw the aircraft at the accident site and landed in the field to assist. A man walking his dog also arrived on the scene to help. The pilot was able to exit his aircraft in the normal manner and received a ride back to Wycombe in the helicopter. His aircraft was later recovered to his workshop. It was later determined that the pilot had suffered from a fractured vertebrae.

Weather

There was no weather reporting station at Aylesbury Airfield but the conditions at three surrounding airports within 24 nm of Aylesbury at the time of the accident, are listed in Table 1 below.

These reports indicate that the air near Aylesbury at the time of the accident was relatively dry. According to the chart in the Civil Aviation Authority's Safety Sense Leaflet on piston engine icing, the temperature/dewpoint spread placed the risk of carburettor icing in the 'Light icing at cruise or descent power' category - the lowest risk of the four categories.

Airport and Time	Temperature	Dew Point	Humidity	Wind
Brize Norton 1300 UTC	2.5ºC	-6.7ºC	51%	13-25 kt from 050º
Benson 1300 UTC	2.6ºC	-6.0ºC	53%	15 kt from 030º
Northolt 1300 UTC	2.3ºC	-8.4ºC	45%	11-25 kt from 040º

Table 1

Weather conditions at local airports at the time of the accident

Description of the aircraft

The Silence Twister (as shown, Figure 1) is a light weight, all-composite, low-wing, kit-build aircraft with a tailwheel configuration and retractable main gear. It has a maximum take-off weight of 420 kg and is powered by a four-cylinder, four-stroke Jabiru 2200A engine, driving a fixed pitch propeller. The aircraft has a fuel tank within the inboard section of each wing with a combined total fuel capacity of 80 litres.

Figure 1
Silence Twister

Examination of the aircraft

The pilot, who was also the aircraft's builder, examined the aircraft in his workshop. He stripped the carburettor but found no fault. The right wing fuel tank had ruptured and a large quantity of remaining fuel escaped when it was moved. The left fuel tank was intact and contained approximately 20 litres of fuel. An examination of the electric fuel pump revealed small particles of resin on the inlet side of the pump. Both fuel tanks also contained particles and flakes of resin. Some particles were also found in the fuel filters inside each tank. However, the filter inside the gascolator downstream of the electric fuel pump was clean apart from a plug of dirt that had become embedded during the forced landing. No other anomalies were found.

Fuel tank construction

The fuel tanks were made by an individual who specialised in composite manufacture. The tanks were constructed from glass reinforced plastic (GRP) wrapped around a plug. A wax releasing agent was applied to the plug to enable the plug to be removed once the GRP had cured. Any remaining wax was then cleaned from inside the tank. Two internal ribs and a closing end-rib were then bonded to the fuel tank using a Derakene Vinyl Ester resin, developed for usage in underground fuel storage tanks. The completed fuel tanks were then pressure tested and shipped to the aircraft kit manufacturer. The aircraft build manual instructed the builder to flush the tanks with water to remove any deposits.

Determination of the origin of the resin particles

The pilot contacted the aircraft kit manufacturer and the Popular Flying Association (PFA) to report his discovery of resin particles in the fuel system. He then travelled to Germany to meet the kit manufacturer and the fuel tank manufacturer. Together they determined that the fuel tank manufacturing process was not ensuring adequate removal of all the wax releasing agent from inside the tank. When the ribs were bonded to the tank using the resin, some resin was bonding inadequately to residual wax deposits inside the tank.

The pilot had flushed his tanks out using water but when the tanks were subsequently filled with fuel the fuel probably helped to remove the poorly bonded resin from the wax, leaving the resin free to enter the fuel lines. It was determined that four other aircraft, three in the UK and one in the USA, had fuel tanks that could have been affected by the same manufacturing problem.

Analysis

The cause of the rough running engine and its eventual complete power loss could have been carburettor icing, but this was unlikely as the air was relatively dry and according to the carburettor icing chart the risk was low, particularly at high power settings. The more likely cause was a restriction in fuel flow caused by the resin particles found in the fuel system. No resin particles were found downstream of the electric fuel pump, but sufficient particles could have built up within the fuel pump to cause a flow restriction or blockage. However, this does not explain why the engine ran normally during the ground run at Aylesbury and then only failed during the takeoff. It is possible that during the ground taxi, with the engine running near idle with a low fuel demand, the fuel restriction was not sufficient to cause a problem and during this period the fuel gascolator was replenished. During the high power engine ground run the fuel demand would have been high but the fuel contents of the gascolator may have been sufficient for the ground run despite a flow restriction at the fuel pump. The aircraft then possibly departed with a low fuel level in the gascolator and insufficient fuel flow to power the engine at takeoff power. Alternatively, the fact that the tanks were switched just prior to takeoff could have introduced some additional resin from that tank causing a fuel flow restriction or blockage.

Safety action

The aircraft kit manufacturer has notified the four other Twister owners of the potential problem with their fuel tanks. Similar problems of contaminated tanks were found. They have been advised to flush their tanks out thoroughly using fuel rather than water. The Twister build manual has also been revised with a note in red text stating:

> *'Important: Before flying, clean the fuel tanks with gasoline properly. Open the fuel tanks after the first five flight hours and control the tanks and filters if there are any particles.'*

In addition the build manual has been revised with instructions to bore six holes of 3 mm diameter into the inlet end of the plastic tube of the filters inside each fuel tank. This is to reduce the potential of a fuel flow blockage at the filter. Furthermore, the fuel tank manufacturer has revised his manufacturing process to more thoroughly remove all wax releasing agent from inside the tank prior to bonding the ribs. The Popular Flying Association has stated that they are satisfied with the safety action taken.

The owner of G-TWST modified the aircraft's fuel system by fitting a new type of fuel pump and adding two new fuel filters which are visible through the landing gear leg mounting holes.