**AAIB Bulletin No: 2/97** **Ref: EW/C96/8/12** **Category: 1.3**

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| **Aircraft Type and Registration:** | DH82A Tiger Moth, G-ANPK | |
| **No & Type of Engines:** | 1 De Havilland Gypsy Major 1 piston engine | |
| **Year of Manufacture:** | 1937 | |
| **Date & Time (UTC):** | 18 August 1996 at 0830 hrs UTC | |
| **Location:** | Clacton Airfield | |
| **Type of Flight:** | Positioning | |
| **Persons on Board:** | Crew - 1 | Passengers - None |
| **Injuries:** | Crew - Major | Passengers - N/A |
| **Nature of Damage:** | Aircraft destroyed | |
| **Commander's Licence:** | Commercial Pilot's Licence with Instructor's Rating | |
| **Commander's Age:** | 46 years | |
| **Commander's Flying Experience:** | 4,000 hours (of which 200 were on type)<br>Last 90 days - 130 hours<br>Last 28 days - 45 hours | |
| **Information Source:** | AAIB Field Investigation | |

## History of flight

On the day of the accident the privately owned aircraft was leased to a company which sells flying lessons in Tiger Moths. One of the company's instructors had intended to fly the aircraft solo to another airfield where the lessons were conducted.

The pilot arrived at Clacton airfield where the aircraft was hangared at about 0800 hrs and commenced her pre-flight checks which included a visual check of the oil and fuel quantities. She did not perform a fuel drain test for contamination because the test had already been completed by one of the aircraft owners who was present. The fuel tank sight gauge indicated about three-quarters full which was consistent with the previous 40 minute flight from a nearby airfield where the tank had been replenished to full with 100LL AVGAS on 9th August. She then strapped into the rear cockpit with the assistance of one of the owners who later 'swung the prop'. The engine started on the first attempt and idled normally. The aircraft was then taxied from beside the hangar towards the threshold of Runway 18, a distance of approximately 500 metres. Whilst taxying the pilot increased engine RPM

to about 1800 and checked each magneto in turn; they both operated satisfactorily. The aircraft stopped briefly at the hold before lining-up for take off from Runway 18 at about 0815 hrs. At the time the weather was fine with scattered cloud at around 25,000 feet, a light southerly wind, a temperature of 20°C and a dew point of 17°C. The visibility was good and the mean sea-level pressure was 1021 mb.

On commencing the take-off run the engine reached the usual speed of around 2000 RPM and the take off proceeded normally. The aircraft became airborne at between 45 and 50 kt but during the climb, at a height between 150 and 200 feet, the engine suddenly stopped producing power and started to splutter. The engine alternately spluttered and recovered to near full power for a few seconds before stopping completely. When the problem first started the aircraft was in the area of the airfield boundary. Along the extended runway centreline the distance between the boundary and the shore is some 600 metres.

An elevated coastal footpath crosses the extended centreline almost at right angles to it. The seaward side of the path is bounded by a continuous masonry wall about three feet high. At the time of the accident two ladies were walking a dog along the path in the direction of Clacton to Jaywick and they were close to the extended centreline when the Tiger Moth took off.

The pilot stated that when the engine faltered, her first choice for a forced landing was the one fairway on the golf course which was parallel to and beside the coastal path but at the time it was populated by golfers. Her second choice was the beach but that had "the same problem with people everywhere". Another option was to land in the sea but she judged that she could not "reach far enough out to sea to guarantee not to hit any swimmers". She also stated that seeing nowhere to land she maintained heading but the aircraft stalled just before the sea wall. She reported that the left wing dropped and the aircraft fell to the ground in a nose-down attitude hitting the sea wall nose-first.

**Injuries**

The pilot did not see the two ladies but they had seen the aircraft coming towards them. Their recollection was of the aircraft being behind them and on their right as they walked towards Jaywick. Their attention was drawn towards it when the engine started misfiring. One of them noticed that the propeller was stationary and that the aircraft had crossed over the sea wall when it commenced a right turn towards them. They both watched the aircraft coming towards them before letting go of the dog and starting to run towards Jaywick. However, they had hardly started running before the aircraft struck them. Both were hit in the back, probably by the wings. One lady was knocked forwards onto the path; the other was knocked over the sea wall, rendered unconscious and pinned upside down by

the weight of the fuselage which had trapped one of her legs against the sea wall. The pilot was severely dazed but able to climb out from the cockpit unaided; the dog was unhurt.

The emergency services were alerted by several witnesses. When they arrived at the scene the lady pinned to the wall had been released from her predicament by the golfers and the aircraft had been secured in position on the wall by people from the airfield. The pilot had been taken to hospital by a friend whilst golfers comforted the injured ladies. One lady received whiplash injuries to her neck, back injuries and cuts and bruises but she was able to leave hospital the same day. The other lady suffered more serious multiple injuries; she required surgery and had to remain in hospital for several weeks. The pilot's shoulder straps broke during impact but the lap strap held; she suffered facial cuts and spinal injuries which prevented her from flying for twelve weeks.

**Witness reports**

When the local fire and rescue service arrived at the scene, fuel was dripping from the underside of the aircraft's fuel tank. The leak was sealed with putty provided by the fire service who then siphoned about 30 litres of fuel from the tank. There was also a considerable quantity of black oil on the ground which had been released when the engine crankcase ruptured on impact.

According to numerous witnesses who had observed the accident sequence, the engine first started to misfire when the aircraft was in the area of the airfield boundary but the aircraft maintained heading until it was about 50 yards on the seaward side of the coastal wall. A right turn was then started but it appeared that control was lost during this turn; the aircraft stalled and entered an incipient spin. At the time there were no boats or windsurfers in the vicinity and witnesses, one of whom was within 200 yards of the accident, reported that there were about 8 to 10 people, widely dispersed, on the beach.

Where the aircraft crashed, at high tide the sea water reaches the sea wall but at low tide there is a sand and pebble beach at least 25 metres wide. Low water on that day occurred about 40 minutes before the accident. Photographs taken about one hour after the accident confirm the evidence of numerous eye-witnesses that the tide was well out and that the beach was virtually deserted.

In the opinion of another Tiger Moth owner who had no knowledge of the accident, it is not possible to taxy several hundred metres, take off and climb to 50 feet if the fuel tap is inadvertently left OFF when the engine is started; in his experience the engine stops after taxying a distance of about 50 metres. On the other hand, nobody reported seeing dark coloured smoke coming from the aircraft

when the engine misfired; dark smoke is symptomatic of a rich-mixture caused by overfuelling which can lead to a 'rich cut'.

**Engineering Observations**

Witness evidence indicated that the engine failure may have been caused by a fuel problem. However, the fuel system was empty and had dried out when the AAIB examined the aircraft and engine. The fuel selector was reported to have been found in the mid-way position immediately after the accident. However, when examined by AAIB there was extensive damage to the linkage between the selector and the fuel cock and also to the structure in this area which made the position of the fuel cock inconclusive.

The Tiger Moth fuel tank holds 18 gallons of fuel, and provides a gravity feed to the engine through a fuel filter. The fuel filter had detached from both the engine and tank fuel lines, and was checked to determine that the screen was clear and that the inlet and outlet were free from obstruction. The air inlet to the tank did not contain a ball valve for inverted flight, as shown on the drawings supplied by the Design Authority, but consisted of a small bore inverted 'U' tube. Therefore the fuel flow rate from the tank was checked to determine whether the air inlet could have allowed a sufficient fuel flow to the engine during takeoff. The full flow rate obtained was 40 gallons per hour, and showed that the air inlet to the tank was unobstructed At the end of this test the air inlet to the tank was blocked and this action was followed by an almost simultaneous decrease in the fuel flow.

The engine had been overhauled in April 1990, its first flight had taken place in July 1991, since when the log book recorded that it had flown for 194 hrs 35 minutes. There were no defects recorded in the log book, although the left hand magneto serial number was different to that recorded as initially installed with the overhauled engine.

A bulk strip of the engine revealed that it had been mechanically satisfactory before the accident.

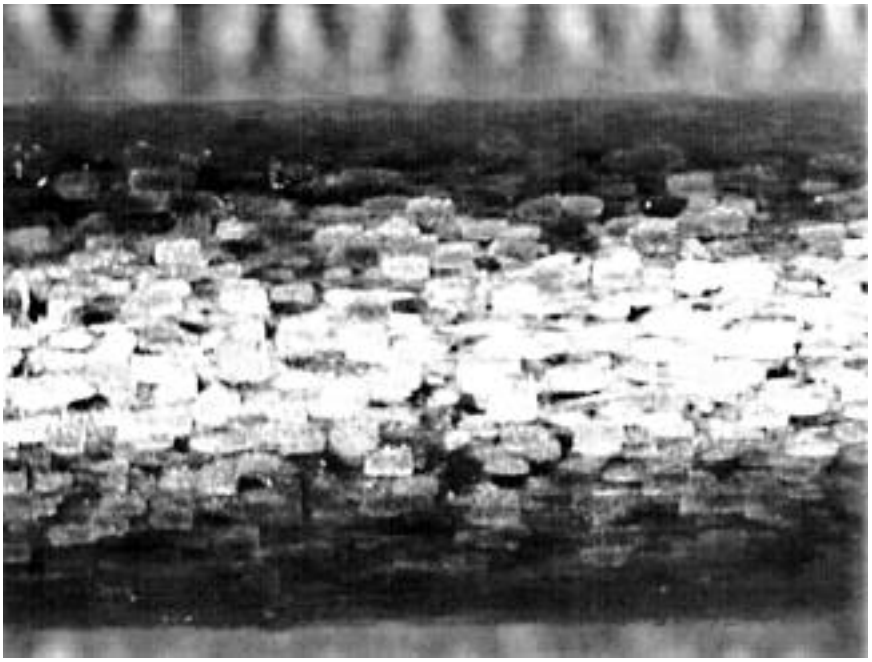
A flow test of the carburettor conducted with a fuel pressure of 4 psi showed that the float chamber needle valve was fully open; however, a subsequent strip examination did not determine whether this was due to the accident or to contamination of the needle valve seat. After the float valve had been reassembled it functioned correctly. Stains and deposits present on both the float needle valve seat and the float needle indicated that, *at some time*, contaminated water had been allowed to dry out in the float chamber.

Probable contamination from dried water deposits

Note: Different magnification used in both photographs

Similar contamination was not found on either the main or power jets, or in the fuel tank.

Various wear patterns on carburettor components indicated that the carburettor had flown for considerably more hours than the time recorded against the engine since overhaul; these components included: the float needle valve, and the float pivot pin and its housing in the float which showed extensive damage due to brinelling.



Diameter 3/16 "
(4.76mm)

The Gypsy engine Technical News Sheet TNS G No 15, dated February 18, 1970 defines the overhaul period for the carburettor as the same as that for the engine to which it is fitted at the commencement of the overhaul life.

One magneto had been removed from its mounting by the impact, and the minimum repairs necessary were made to enable it to be run; both magnetos performed satisfactorily under test.

The rear seat height had been raised by a 4 inch pad of corrugated cardboard; this undoubtedly absorbed some energy during the impact and prevented the pilot receiving more serious spinal injuries.

The front and rear cockpits were each equipped with a Sutton harness. The shoulder straps in the rear cockpit had both failed during the impact, but the pilot did not report any bruising in that area. As the straps had a design ultimate strength of 1100 lb it was considered that the straps had failed well before this load was achieved. Tensile tests were carried out on a portion of each shoulder strap, and gave loads to failure of between 256 and 518 lb It was noted that successive tests on the straps gave failures at higher loads as the weakest 'link' failed each time; this indicated that the original failures during the accident may have occurred at loads less than those seen during the tests.

There was no indication, either on the harness or in the log book, of the age of the harness, and the flax webbing material from which it constructed looked grubby, but not significantly deteriorated. The harness was an 'on condition' item and no periodic test load was called for in the maintenance schedule; the evidence from this accident indicates that other similar harnesses may be in use, but in a seriously degraded condition.

Recommendation 96-59 stated:

'The CAA should give detailed consideration to requiring a programme of sample testing of aircraft harnesses aimed at establishing their fitness for continued use and, if necessary, imposing a life limitation.'

The CAA have stated that their investigation will look at all types of harnesses, including the Sutton harness.