DH82A Tiger Moth, G-ANPK

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

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) Last 90 days - 130 hours Last 28 days - 45 hours
Information Source:	AAIB Field Investigation

History of flight

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

The pilot arrived at Clacton airfield where the aircraft was hangaredat about 0800 hrs and commenced her pre-flight checks which includeda visual check of the oil and fuel quantities. She did not performa fuel drain test for contamination because the test had alreadybeen completed by one of the aircraft owners who was present. The fuel tank sight gauge indicated about three-quarters fullwhich was consistent with the previous 40 minute flight from anearby airfield where the tank had been replenished to full with100LL AVGAS on 9th August. She then strapped into the rear cockpitwith the assistance of one of the owners who later 'swung theprop'. The engine started on the first attempt and idled normally. The aircraft was then taxied from beside the hangar towards thethreshold of Runway 18, a distance of approximately 500 metres. Whilst taxying the pilot

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

On commencing the take-off run the engine reached the usual speedof around 2000 RPM and the take off proceeded normally. The aircraft became airborne at between 45 and 50 kt but duringthe climb, at a height between 150 and 200 feet, the engine suddenlystopped producing power and started to splutter. The engine alternatelyspluttered and recovered to near full power for a few secondsbefore stopping completely. When the problem first started theaircraft was in the area of the airfield boundary. Along theextended runway centreline the distance between the boundary andthe shore is some 600 metres.

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

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

Injuries

The pilot did not see the two ladies but they had seen the aircraftcoming towards them. Their recollection was of the aircraft beingbehind them and on their right as they walked towards Jaywick. Their attention was drawn towards it when the engine startedmisfiring. One of them noticed that the propeller was stationaryand that the aircraft had crossed over the sea wall when it commenceda right turn towards them. They both watched the aircraft comingtowards them before letting go of the dog and starting to runtowards Jaywick. However, they had hardly started running beforethe aircraft struck them. Both were hit in the back, probablyby the wings. One lady was knocked forwards onto the path; theother was knocked over the sea wall, rendered unconscious andpinned upside down by the weight of the fuselage which had trappedone of her legs against the sea wall. The pilot was severely dazedbut able to climb out from the cockpit unaided; the dog was unhurt.

The emergency services were alerted by several witnesses. Whenthey arrived at the scene the lady pinned to the wall had beenreleased from her predicament by the golfers and the aircrafthad been secured in position on the wall by people from the airfield. The pilot had been taken to hospital by a friend whilst golferscomforted the injured ladies. One lady received whiplash injuriesto her neck, back injuries and cuts and bruises but she was ableto leave hospital the same day. The other lady suffered moreserious multiple injuries; she required surgery and had to remainin hospital for several weeks. The pilot's shoulder straps brokeduring impact but the lap strap held; she suffered facial cutsand spinal injuries which prevented her from flying for twelveweeks.

Witness reports

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

According to numerous witnesses who had observed the accidentsequence, the engine first started to misfire when the aircraftwas in the area of the airfield boundary but the aircraft maintainedheading until it was about 50 yards on the seaward side of thecoastal wall. A right turn was then started but it appeared thatcontrol was lost during this turn; the aircraft stalled and enteredan incipient spin. At the time there were no boats or windsurfersin the vicinity and witnesses, one of whom was within 200 yardsof 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 reachesthe sea wall but at low tide there is a sand and pebble beachat least 25 metres wide. Low water on that day occurred about40 minutes before the accident. Photographs taken about one hourafter the accident confirm the evidence of numerous eye-witnessesthat the tide was well out and that the beach was virtually deserted.

In the opinion of another Tiger Moth owner who had no knowledgeof the accident, it is not possible to taxy several hundred metres,take off and climb to 50 feet if the fuel tap is inadvertentlyleft OFF when the engine is started; in his experience the enginestops after taxying a distance of about 50 metres. On the otherhand, nobody reported seeing dark coloured smoke coming from theaircraft when the engine misfired; dark smoke is symptomatic ofa rich-mixture caused by overfuelling which can lead to a 'richcut'.

Engineering Observations

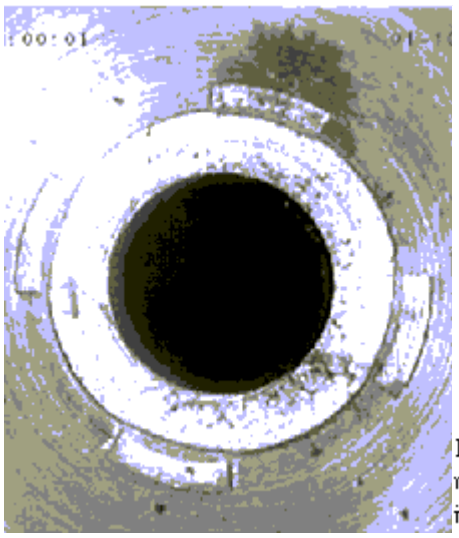
Witness evidence indicated that the engine failure may have beencaused by a fuel problem. However, the fuel system was emptyand had dried out when the AAIB examined the aircraft and engine. The fuel selector was reported to have been found in the mid-wayposition immediately after the accident. However,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

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

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

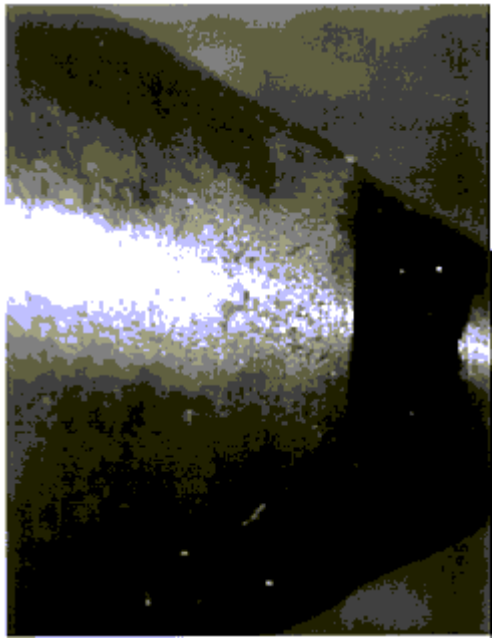
A bulk strip of the engine revealed that it had been mechanicallysatisfactory before the accident.

A flow test of the carburettor conducted with a fuel pressureof 4 psi showed that the float chamber needle valve was fullyopen; however, a subsequent strip examination did not determinewhether this was due to the accident or to contamination of theneedle valve seat. After the float valve had been reassembledit functioned correctly. Stains and deposits present on boththe float needle valve seat and the float needle indicated that,*at some time*, contaminated water had been allowed to dryout in the float chamber.



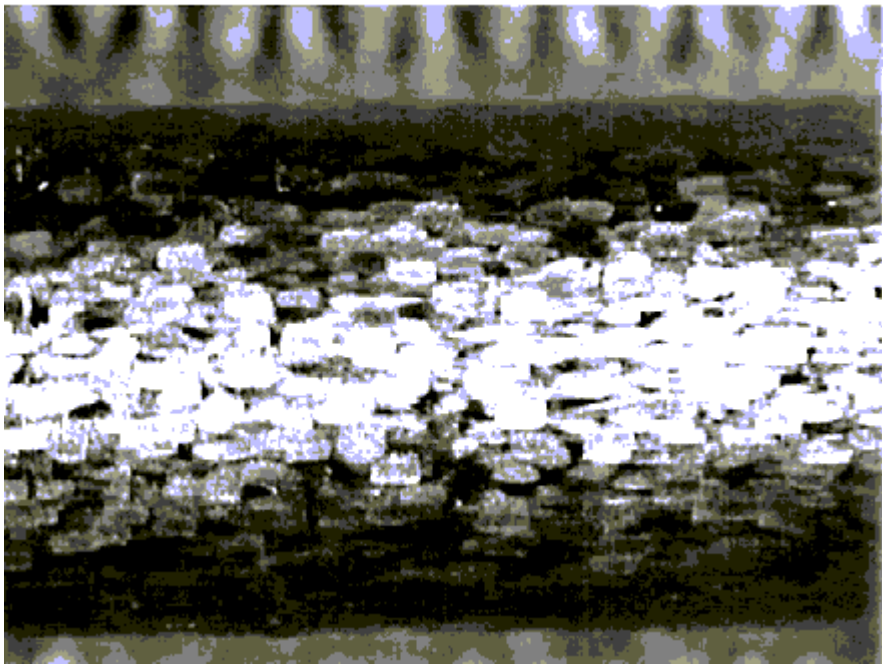
Probable contamination from dried water deposits

Note: Different magnification used in both photographs



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

Various wear patterns on carburettor components indicated thatthe carburettor had flown for considerably more hours than thetime recorded against the engine since overhaul; these componentsincluded: the float needle valve, and the float pivot pin andits housing in the float which showed extensive damage due tobrinelling.



The Gypsy engine Technical News Sheet TNS G No. 15, dated February18, 1970 defines the overhaul period for the carburettor as thesame as that for the engine to which it is fitted at the commencementof 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 berun; both magnetos performed satisfactorily under test.

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

The front and rear cockpits were each equipped with a Suttonharness. The shoulder straps in the rear cockpit had both failedduring the impact, but the pilot did not report any bruising inthat area. As the straps had a design ultimate strength of 1100lb it was considered that the straps had failed well before thisload was achieved. Tensile tests were carried out on a portionof each shoulder strap, and gave loads to failure of between 256and 518 lb It was noted that successive tests on the straps gavefailures at higher loads as the weakest 'link' failed each time;this indicated that the original failures during the accidentmay 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 fromwhich it constructed looked grubby, but not significantly deteriorated. The harness was an 'on condition' item and no periodic test loadwas called for in the maintenance schedule; the evidence fromthis accident indicates that other similar harnesses may be inuse, but in a seriously degraded condition.

Recommendation 96-59 stated:

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

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