Grob G115, G-BOPU

AAIB Bulletin No: 7/2002	**Ref: EW/C2001/08/08**	**Category: 1.3**
Aircraft Type and Registration:	Grob G115, G-BOPU	
No & Type of Engines:	1 Lycoming O-235-H2C piston engine	
Year of Manufacture:	1988	
Date & Time (UTC):	9 August 2001 at 2010 hrs	
Location:	Manchester (Barton)	
Type of Flight:	Training	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to nosewheel and propeller	
Commander's Licence:	Commercial Pilot's Licence with Instrument Rating	
Commander's Age:	37 years	
Commander's Flying Experience:	1,396 hours (of which 58 were on type) Last 90 days - 122 hours Last 28 days - 43 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by AAIB	

History of the flight

The training flight was planned as a circuit detail from Barton airfield using Runway 32. The pre-flight inspection was carried out by the student. After start the internal and engine power checks were completed and the aircraft was taxied to the threshold. The fuel gauge indicated full. The student was briefed for a short field take-off and once airborne commenced a left hand circuit. As the aircraft positioned downwind the pre-landing checks were completed but at approximately 800

feet agl the engine lost power. The instructor immediately checked the mixture control, took control of the aircraft and transmitted a Mayday call.

The instructor considered a left turn to land back on Runway 09 but assessed that the risk of hitting nearby pylons and power cables was too high. Having selected a golf course fairway to the west of the airfield as the only suitable landing site, he informed the tower, selected full flap, switched off the battery master switch and completed all the emergency checklist items. As the aircraft landed on the fairway the instructor braked heavily but he was unable to prevent the aircraft striking a grass bank located around the green. The nose gear failed on impact with the bank and the aircraft skidded to a halt. Both occupants vacated the aircraft without injury.

Personnel from the maintenance organisation arrived on the scene some time later and on checking the aircraft found that the fuel tank was empty, however, when the battery master was switched on the gauge indicated full.

Previous maintenance and flying activity

The annual inspection for the aircraft had just been completed that day. This did not involve any work on the fuel indicating system, but the fuel tank had been removed to provide access. Once the inspection had been completed the aircraft was refuelled with approximately 30 litres of fuel. The engineer recalls checking that there was an indication on the fuel gauge, but he did not register that the full fuel indication on the gauge did not agree with the amount he had put in the tank. A 20 minute engine ground run was performed on the aircraft after the inspection.

When the aircraft was returned to service the instructor performed a thorough external check and, because he knew the fuel tank had been removed and subsequently replaced, took a large sample of fuel by operating the drain. The sample was clear and free from debris. He also noted that the fuel contents gauge indicated full. He then flew the aircraft in the circuit for one hour and reported that the fuel gauge was not 'stuck' and had responded to gusts. On landing he reported that the gauge indicated 'nearly full'.

Investigation of the fuel system

The aluminium fuel tank has a capacity of 100 litres and is located aft of the seats and beneath the floor of the baggage compartment. Because of its location the fuel contents cannot be checked visually. The level of fuel in the tank is sensed by a plastic float, housed in an immersion tube, which is connected to a resistance wire sensor that transmits an electrical signal proportional to fuel quantity. The fuel quantity is displayed on a gauge on the instrument panel. Operating experience has shown that this gauging system is historically very reliable.

The maintenance organisation carried out an investigation into the fuel indicating system following the accident and no faults were found. It was concluded therefore that the 'full' indication was probably caused by the fuel tank transmitter float having stuck at the full position.

There is a manufacturer's option to fit a visual sight gauge to the aircraft. This option adds a clear tube alongside the tank. A clear panel is installed into the side of the fuselage adjacent to the tank to allow the pilot to view the fuel level in the tube. This early model of Grob115 was type certificated in 1985 by the LBA in Germany, and accepted by the CAA under Airworthiness Approval Note No 20405. Later models of Grob 115, namely the G115D2, are fitted with wing tanks where it is possible to visually check the fuel.

Discussion

It was concluded that the engine failed due to lack of fuel. Several opportunities existed however for the fuel gauge inaccuracy to be noticed:

1. The fuel tank had been removed during maintenance and the engineer, when refitting the tank, had not noticed that the full indication was inconsistent with the amount of fuel he had added.

2. Two instructors had accepted the 'full' indication on the fuel gauge as being correct and it was apparent that it was not common practice for pilots to reconcile the aircraft's previous flight times and fuel burn against fuel remaining and fuel uplift.

> [The flying club had operated two Grob 115 aircraft for 12 years, and throughout that period the fuel gauging system had always been reliable. With no visual means of checking the fuel quantity and with the perceived reliability of the fuel gauging system, they had therefore relied solely on the fuel gauge to assess fuel quantity. They had also not queried the full indication. The aircraft is not normally refuelled to full because with two occupants of medium build or larger, the maximum take-off weight for the aircraft could be exceeded. Both the instructor and student were of light build and therefore could accept the aircraft with a full tank].

Approximately 100 examples of this aircraft with this fuel tank configuration have been manufactured. Eight aircraft, operating in Australia, are equipped with the visual sight gauge. The manufacturer has no record of fuel gauging failures. In Australia however, there have been reports from operators of unreliable indications caused by corrosion.

The CAA recognise that fuel gauges fitted to light aircraft can sometimes be unreliable and publish advise to private pilots accordingly. The CAA General Aviation Safety Sense Leaflet 1C, titled '*Good Airmanship Guide*' emphasises that pilots should 'determine visually that you have enough fuel of the right type. If necessary, use a dip-stick to check fuel levels'...

In this model of aircraft however it is not possible to check the fuel visually. Furthermore, because the fuel tank is located below and forward of the filler cap, it is not possible to 'dip' the tank. The exact amount of fuel can only be confirmed when the tank is full by overfilling the tank and allowing fuel to spill out of the filler cap

Previous recommendation

AAIB Bulletin 9/2001, reported on an accident to a Piper PA34-220T, G-OMAR, which also ran out of fuel. The report highlighted the difficulties in establishing the exact amount of fuel on-board on types where it is not possible to visually check the fuel level. The report recommended that:

The CAA 'should ensure that operators of twin light aircraft (all types similar to the PA34) in the Transport Category (Passenger) have an effective back-up procedure, in addition to the aircraft fuel gauges, by which the fuel remaining in tanks after flight may be established and recorded' (Recommendation 2001-67).

The CAA accepted the recommendation for public transport operations but only partially accepted the recommendation for non-public transport operation 'as it was unable to ensure compliance on this type of operation, being only able to issue advice and guidance'.

Guidance for aircraft not operated by Air Operators' Certificate Holders was published by the CAA in the General Aviation Safety Information Leaflet (GASIL) Issue 5 of 2001. Owners and operators were reminded of the unreliability of many light aircraft fuel gauges, and advised of the necessity for regular re-fuelling to a level which can be visually checked and technical log records amended accordingly.

The aircraft involved in this accident had no means by which the fuel quantity could be visually checked. The only indication available was that displayed on the fuel gauge which on this occasion was inaccurate. Furthermore no fuel reconciliation procedure was in place.

Recommendation 2002-10

It is therefore recommended that the Design Authority in Germany, the Luftfahrt Bundesamt with the assitance of the aircraft manufacturer, Grob Werke Gmbh & Co KG, review the reliability of the fuel gauging system on the Grob G115, G115A and G115B aircraft and consider mandating the installation of an additional means by which the fuel quantity can be checked.

Recommendation 2002-11

It is further recommended that the CAA encourage flying clubs to have in place an effective procedure that enables pilots to reconcile aircraft fuel state against fuel used and fuel uplifted to act as a back-up procedure to cater for the possibility of unreliable aircraft fuel gauge(s).