Reims Cessna FA152, G-BILK

AAIB Bulletin No: 11/2001	**Ref: EW/G2001/04/11**	**Category: 1.3**
Aircraft Type and Registration:	Reims Cessna FA152, G-BILK	
No & Type of Engines:	1 Lycoming O-235-L2C piston engine	
Year of Manufacture:	1980	
Date & Time (UTC):	18 April 2001 at 1230 hrs	
Location:	Near Exeter Airport, Devon	
Type of Flight:	Training	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damaged beyond economic repair	
Commander's Licence:	Basic commercial Pilots Licence with Instructors Rating	
Commander's Age:	42 years	
Commander's Flying Experience:	701 hours (of which 573 were on type)	
	Last 90 days - 128 hours	
	Last 28 days - 64 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries	

History of the flight

The instructor and student were engaged on a cross-country exercise from Exeter to Compton Abbas, Dorset and return. The weather was fine with good visibility, few clouds at 3,000 feet, surface wind of 020°/08 kt, temperature +8°C and a dew point of -1°C. Prior to departure from Exeter the instructor reported that the contents of the aircraft's long range fuel tanks were not balanced and indicated 1/2 and a 1/4 for the left and right tanks respectively. He assumed that this imbalance was due to a gravity transfer of fuel between tanks as the aircraft had been parked overnight on an uneven surface. He checked the contents using a fuel dipstick marked accordingly. The 40 minute flight to Compton Abbas was completed without incident.

Prior to departure for the return sector to Exeter the fuel tanks contents, as indicated on the gauges, indicated 1/2 in the left tank and less than 1/4 in the right. On the return sector approximately 4 nm from Exeter and after 38 minutes airborne, the aircraft suffered a total power loss. The instructor took control, transmitted a 'Mayday' and carried out the engine failure checks. Pumping of the throttle restored power intermittently but this was insufficient to prevent a forced landing. The aircraft touched down in a small field pitching inverted when the nose landing gear dug into soft ground. The pilot and student, who were both wearing full safety harnesses, vacated the aircraft without injury. Post accident examination of the aircraft showed the carburettor heat control selected to hot, the mixture set to fully rich, the throttle open and the fuel cock selected on.

The instructor reported that with hindsight he suspected that only the right tank had been supplying the engine with fuel. Examination of the fuel feed pipes from both tanks showed that there was no obstruction to the flow of fuel from either tank.

Fuel analysis

Some time after the accident samples of fuel were taken from the aircraft centre drain and from the nozzle end of the fuel bowser at Exeter Airport. These samples were sent to the Defence Evaluation and Research Agency (DERA) for analysis. Both samples were found to comply with the specification for AVGAS 100LL

Minimum fuel states

The flying club 'Flying Order Book' includes a section regarding 'Minimum Fuel States'. The relevant extract is reproduced below:

> Cross-counrty flights are to be planned so that on completion of the flight the aircraft has sufficient fuel for flight to the alternate, plus 10% plus 30 minutes at the cruise consumption for the aircraft. In all cases fuel states are to form part of the flight log.
>
> Normally aircraft on local flying should not take off unless the tanks are half full or more (except in the case of an intended aerobatic flight). After landing if the Fuel State is significantly less than half full the aircraft should be refuelled before parking.
>
> In the event of uneven fuel feed, the pilot is to operate as though both gauges read the same as the lower one of the two.

Aircraft dipsticks

An appendix to the 'Aircraft Handling' section of the flying order book contains an entry relating to 'Aircraft Fuel Tank Dipsticks -Use of Markings'. The following is an extract from that appendix:

1. Each aircraft has been provided with its own individually marked dipstick indicating

   FULL 3/4 1/2 and 1/4 full

2. Each dipstick is identified with the aircraft registration engraved in the wooden handle.

3. When using a dipstick pilots are to ensure that:-

(a) they are clean before use
(b) they are not put on the ground
(c) only the dipstick for that particular aircraft is used
(d) the fuel tank filler caps are securely replaced
(e) the dipstick is put back in the aircraft in the seat back pocket or in such a place that it will not become a loose article in flight or get caught in the seat adjustment mechanism.

1. Cessna G-BILK has long range tanks and with two persons on board a fuel required and weight and balance calculation must be carried out

2. (Not relevant to this report)

3. The endurance of any club aircraft should be ascertained by consulting the performance section of the pilot's operating handbook, owner's manual or flight manual as appropriate for each aircraft. Nominal safe endurance is four hours on full standard tanks.....

A second appendix to the 'Aircraft Handling' section contains a diagram of the dip-stick used for G-BILK. The diagram shows a dipstick marked with the following: 1/4; 1/2; 3/4; FULL. Alongside each mark are amounts of fuel in imperial gallons as follows: 7 1/4; 14 1/4; 21 3/4 and 29.

Analysis

The total capacity of G-BILK's long range tanks is 31.6 imperial gallons (standard tank capacity is 21.7 imperial gallons) with 1.25 gallons unusable in each tank. This total is divided between the two tanks (one in each wing). A dipstick can only be used to sample one tank at a time, therefore, if the fuel reaches the full mark on dipping the tank it confirms that 15.8 imperial gallons are present; and not the 29 gallons suggested by the 'Flying Order Book'.

A pilot flying G-BILK could be misled on the amount of fuel in the aircraft if he takes note of the somewhat misleading information in the 'Flying Order Book' regarding the dipstick measured amounts. Measuring a 1/2 on the dipstick in the left tank and 1/4 in the right may lead a pilot to calculate that the amount of fuel on board is 14.5 gallons in the left and 7.25 gallons in the right tank making a total of 21.75 gallons. In reality the amount would be 7.6 gallons and 3.95 gallons in the left and right tanks respectively. This makes a total of 11.55 gallons of which 2.5 gallons (1.25 gallons per tank) are unusable. Therefore, at an assumed consumption rate of 4 gallons per hour, and with only 9.05 gallons of usable fuel the aircraft's endurance to dry tanks will be 2 hours 15 minutes; more than adequate for a return flight to Compton Abbas if both tanks are feeding.

The flight time to Compton Abbas took 40 minutes. Accounting for start and taxi time the aircraft would have used approximately 2.7 gallons. According to the pilot's report this fuel appears to have been come mainly from the right tank for on arrival at Compton Abbas the left tank contents appeared not to have diminished. The exact amount of fuel in each tank was therefore in doubt. As the reading on the gauges could not be relied upon the only way to determine, with any accuracy, the amount of fuel on board was to dip the tanks again. The pilot did not carry out this task relying for his calculation on the fuel measured at Exeter minus the assumed consumption en-route. If only the right tank was feeding the engine on the outbound flight the aircraft would have arrived with approximately 1.25 gallons in the right tank giving an endurance of only 18 minutes. The engine

however suffered a power loss 38 minutes into the return flight. Therefore, some fuel must have been feeding from the left tank but at a rate insufficient to sustain the engine when fuel feed from the right tank was no longer available.

Follow-up action

As a result of this accident the flying club has amended the 'Flying Order Book' to show the correct amounts of fuel present in each tank corresponding to each mark on the dipstick.