AAIB Bulletin No: 3/93 **Ref: EW/C92/10/1** **Category: 1c**

Aircraft Type and Registration:	Cessna F172D, G-ASHA
No & Type of Engines:	1 Rolls-Royce Continental O-300-D piston engine
Year of Manufacture:	1963
Date & Time (UTC):	4 October 1992 at about 1705 hrs
Location:	Westover Farm, Sheepwash, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - Fatal Passengers - 2 Serious, 1 Minor
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence with Night and IMC ratings
Commander's Age:	51 years
Commander's Flying Experience:	790 hours (of which about 500 were on type)
Information Source:	AAIB Field Investigation

History of flight

The aircraft was flown from East Midlands Airport to Westover Farm where it landed at about 1130 hrs. The airstrip orientated 17/35, was 800 metres long and 35 metres wide, and had no runway markings; it sloped, in parts steeply, uphill in the 35 direction. The surface was of grass and clover, about 10 cm in length; it was in good condition and generally smooth and unrutted. On the day of the accident the surface was wet but generally firm.

An airstrip information sheet had been sent to the pilot some six weeks prior to the flight, however, on arrival the aircraft was met by the owner of the farm who briefed him personally on the characteristics of the airstrip as they walked along part of it. He pointed out that, because of the slope of the field, it was normal to take-off in a southerly direction. The pilot asked if there was a refuelling facility; when told there wasn't he asked whether any cans were available which he might use to collect some fuel. The owner had four 20 litre jerricans of 'four star' petrol which was stored for use in his domestic vehicles; it had been purchased recently from a local filling station. This was offered to the pilot who accepted and the aircraft was refuelled. He used fuel from three of the jerricans, a total of 60 litres,

and this appeared to fill the tanks. The aircraft was parked on a slope so the total fuel on board would have been slightly less than maximum.

At about 1600 hrs, when the pilot and the three passengers returned to the strip, it was noted that fuel was leaking from the wing area and so the aircraft was manhandled to position it so that the wings were level. The aircraft was preflight checked and the pilot again walked along part of the airstrip. When he returned he and the passengers boarded the aircraft. He advised the passengers to tighten their seat belts because he intended to abandon the take-off if the aircraft was not airborne by halfway along the airstrip. The engine was started and checked, and the aircraft was taxied to the southern end of the airstrip.

Wheel tracks observed on the airstrip and witness accounts indicated that the first take-off attempt was in the 35 direction; this was abandoned and the aircraft, continuing in the same direction, taxied to the northern end of the airstrip. An attempt was then made to take-off in the 17 direction; this was also abandoned. A second attempt to take-off in the 35 direction was unsuccessful and the aircraft was taxied back to the southern end of the airstrip.

The next take-off attempt was made diagonally across the runway on a track of approximately 355°(M). The aircraft became airborne just before the edge of the strip, struck a wooden post, probably with its left mainwheel spat, and climbed away to the north-east over the steeply rising ground. As the aircraft approached the perimeter of the field all three passengers heard the audio stall warning sound. It then descended rapidly from about 20 to 30 feet agl, passed under a powerline, hit the top of a hedge which bordered the northern edge of the field and came to rest against the far bank of the lane beyond the hedge. Only one, very localised, area of damage could be seen in the hedge and it appeared that this had been made by the aircraft's left main landing gear leg. This suggested that the aircraft had been banked quite markedly to the left as it descended and the relation of this damage to the aircraft's subsequent contact with the ground showed that it had also been descending with a nose down pitch attitude.

The impact caused both doors to spring open and the two rear seat occupants made their escape through them. Both front seat occupants were rendered unconscious by the impact; the person in the right seat was released and pulled clear by one of the rear seat occupants while the other attempted to release the pilot. A small fire started which rapidly increased in intensity. The two rear seat occupants continued their combined effort to release the pilot until smoke and flames made further attempts impossible. Post mortem examination of the pilot revealed no pre-existing medical condition which would have contributed to the accident.

Weather

An aftercast for the area was provided by the Meteorological Office at Bracknell. There was a strong north-easterly airflow over south-west England. The following conditions existed in the general area:

Surface wind	040°/15 to 20 kt, with gusts of 30 to 35 kt
Visibility	10 km or more
Cloud	Scattered cumulus, base 2,000 feet
Temperature	+ 14°C
Dew point	+ 9°C

Witnesses in the area reported that the wind was fairly strong from the north-east but there were no significant gusts around the time of the accident. The reported temperature and dewpoint were such that serious carburettor icing could be encountered at any power condition. The risk and severity of carburettor icing could also have been increased by the prolonged period the aircraft spent taxiing and attempting to take-off over the wet grass surface.

Examination of Aircraft

Fire had destroyed the cabin and had severely damaged the engine compartment. The left fuel tank had been partially destroyed by fire and its fuel lost or consumed. The right tank was intact and 27 litres of fuel were recovered from it. The glass bowl of the fuel strainer, positioned on the front face of the firewall at its bottom right corner, had been broken in the impact and fuel would have been free to drain from the tanks into the engine compartment and on to the ground. The strainer did not show any sign of pre-existing gross contamination or blockage. With the destruction of the cabin by fire the wings had subsided on to the ground but there was no evidence to suggest that they had been displaced or substantially damaged by impact. Pre-fire damage to the fuselage appeared to have been limited to collapse of the noseleg, crushing of the engine compartment and the front of the cabin and some buckling and collapse of the fuselage aft of the cabin. The propeller showed no evidence of power and only the lightest evidence of rotation.

All of the consumable material in the cabin furnishings and controls had been destroyed. The throttle, mixture, carburettor air controls and the primer knob were all found to be in the fully forward position although, as their slider tubes were undistorted, it was possible that they might have been at some other position at impact but had been pushed forward during the impact or during the rescue attempts. The magneto and starter switch was not found. The fuel cock was found and X-ray examination showed it to be in the 'BOTH' position. The throttle butterfly was fully open and the carburettor hot

air valve closed as consistent with the pilot's controls. The flap lever was found to be engaged in the second detent ie first stage of flap had been selected.

The engine, magnetos and carburettor were stripped and examined by an engine overhaul agent under AAIB supervision. No mechanical failure or deficiency was found which could have caused a loss of power. The magnetos and their associated wiring were so badly damaged by fire that nothing could be deduced about their pre-crash condition. When power failure is caused by carburettor icing evidence of the resulting rich mixture is sometimes available as a thick layer of soot on the sparking plugs. The plugs from G-ASHA, however, were clean and their condition was consistent with normal running. Some plugs showed slight lead contamination but all were tested under pressure conditions and all operated correctly. Some of the engine's internal components showed evidence of heat effects from the post crash fire and were discoloured and contaminated with carbon. Leak checks were carried out on the valves when the cylinders had been removed from the engine and No 1 exhaust valve was found to be not fully closed. It was, however, easily freed and it settled to the closed position. Nos 2 and 5 exhaust valves were also stuck, No 5 had to be driven out of its guide, but they were in the closed position. When the valves and guides were checked dimensionally five showed loss of clearance or interference where there was a build-up of carbon at the foot of the valve or guide. Inspection of these valves indicated that there had been appropriate initial clearances between the stems and guides. None of the pushrods were bent and there was no other evidence of damage or distress in the valvegear system which would indicate that a valve or valves had been seizing in operation.

The engine had been overhauled at the end of 1988 but in May 1990 it had suffered a carburettor fire and investigation revealed that the valve gear had been damaged and that the valve guides were undersized. Following repair the engine was initially operated on 'straight' SAE 80 mineral oil and, though its operating time could not be accurately determined, it had probably run for approximately 65 hours since the repair.

Fuel samples from the supply at East Midlands Airport were retained, following the accident, and were sent for analysis by the Fuels Laboratory at DRA Woolwich together with fuel recovered from the right wing tank of G-ASHA. The supply samples (five in all, from different locations in the supply system and vehicle) all conformed to specification for Avgas 100LL and showed no signs of contamination. The sample from the aircraft was consistent with being a mixture of Avgas 100LL and 4-star motor fuel and when compared with the AVGAS 100LL specification it was deficient in the Distillation Final Boiling Point and Reid Vapour Pressure criteria. The fuel mixture was also deficient in Lean mixture Octane Number, a figure of 92 being returned as compared to the 100LL specification of 99.5. The fuel's volatility characteristics are relevant to the circumstances of the accident in that they would

increase the engine's susceptibility to carburettor icing. A test for alcohol as a constituent of the fuel proved negative.

The Civil Aviation Authority's Airworthiness Notice (AN) No. 98, 'USE OF MOTOR GASOLINE (MOGAS) IN CERTAIN LIGHT AIRCRAFT' lists a large number of Cessna 172 variants as aircraft in which four star motor gasoline may be used but the 172D is not included. Its omission is almost certainly the result of no application having been received by the CAA specifically for the 172D aircraft; the CAA grants such exemptions only on request and, currently, only for individual variants of a given aircraft. It is likely, therefore, that an exemption would have been granted had such an application been made. Mogas which is obtained directly from a filling station forecourt rather than an aerodrome supply is subject to the provisions of AN 98A which requires that such fuel conforms to BS 4040, has not been rendered unfit by contamination or its method of storage, that records of supply have been maintained and that the aircraft is placarded with operating limitations. AN 98A also requires that the fuel does not contain alcohol and a simple test for alcohol is given.

Aircraft Performance

A survey of the field showed that the average slope over the aircraft's take-off run was 1.9% upwards to the point at which it finally left the ground. If it had continued in the direction of the airstrip then it would have had to achieve a climb gradient of 8.8% to clear the trees at the northern end. The measured ground run was about 420 metres. To the point at which the aircraft struck the post at the side of the strip, 90 metres from lift-off, it achieved a climb gradient of about 8%. From this point the gradient required to clear the sloping ground and the powerlines at the northern end of the field was about 5.5%. The post was slightly to the left of the aircraft's take-off track and this may signify that the aircraft was blown left after lift-off by the crosswind. The track from the location of the post to the impact position 250 metres further on was approximately 006°(M); some 11° to the right of the take-off run.

It was estimated that the weight of the aircraft was of the order of 2,300 lb, the maximum permitted for take-off. The gross gradient of climb from the end of the take-off distance, for the still air case, was derived by adding 2% to the net gradient determined from the Flight Manual graph. With a take-off safety speed of 66 mph (57 kt) and wing flaps retracted, the gross gradient was calculated to be 9%. Assuming this gradient from the end of the still air take-off distance would imply that, in a straight climbout, the aircraft would have passed over the powerlines by about 22 feet. The prevailing headwind component, estimated to have been at least 10 kt, would have significantly increased this figure, probably to about 35 feet. It was considered that the amount of flap which was found to have been selected would not have significantly affected this figure. Two factors would, however, have led

to a significant reduction in the gradient of climb. The first was a degradation of aircraft's actual climb performance compared with the Flight Manual figure; this is common in older aircraft. An airtest, in G-ASHA, carried out by the CAA on 21 February 1992 determined that in a climb with a mean altitude of 6,725 feet, the rate of climb was 470 feet/min; this was found to be 60 feet/min below that scheduled. Secondly, and possibly more critically, the aircraft turned right through at least 11° shortly after take-off; a manoeuvre which could have caused a marked reduction in the climb gradient.