Piper PA-28-140, G-OSOW, 18 December 1999 at 1136 hrs

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Aircraft Type and Registration:	Piper PA-28-140, G-OSOW
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1967
Date & Time (UTC):	18 December 1999 at 1136 hrs
Location:	Bournemouth International Airport, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 2
Injuries:	Crew - 1 (Fatal) - Passengers - 2 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	222 hours (of which 174 were on type) Last 90 days - 36 hours Last 28 days - 5 hours
Information Source:	AAIB Field Investigation

History of the flight

A recently qualified flying instructor was briefed by the Chief Flying Instructor (CFI) of a flying club to give a trial lesson to a customer. The flight was to be of 40 minutes duration and involved a local area familiarisation and general aircraft handling.

On the day of the accident the CFI and the flying instructor arrived at 0930 hrs and, having checked that the weather was suitable for the flight, undertook a briefing on the local area and the content of the trial lesson. The CFI went to the aircraft with the instructor in order to show him the location of the aircraft documents and suggested that, when ready, the instructor should check the aircraft and see that the fuel tanks were 'filled to the tabs'. The supervising QFI for the day, on returning from a flight, also checked that the instructor was fully briefed. He agreed that the flight should route from Bournemouth Airport to Hengistbury Head, on to the Isle of Wight and return to Bournemouth, on the way demonstrating and explaining the use of the controls. Whilst the student should be given control during the flight this should not be permitted during the take off.

The trial lesson student and his family arrived at 1035 hrs for an 1100 hrs departure. Having completed some administration details they returned to their car whilst the aircraft was refuelled. The instructor had requested full fuel for the flight and this was questioned on two separate occasions by the person carrying out the refuelling as the normal procedure for the club aircraft was only 'to the tabs' as stated by the CFI. The weight difference from 'tabs' to full equates to an additional 100 lbs.

The instructor booked out with Bournemouth ATC for a VFR flight to the South East but incorrectly stated that there were only two persons onboard. A video recording taken by a member of the student's family shows the instructor, student and passenger walking out to the aircraft and boarding it. The instructor occupied the front right seat, the student the front left and the passenger was seated in the left rear. It could be seen that the front windscreen was heavily misted; to a greater degree than the adjacent parked aircraft. At 1126 hrs G-OSOW ('OW') requested taxi clearance which was granted at 1127 hrs for the holding point of Runway 26.

The airport Rescue and Fire Fighting Services (RFFS) had deployed to a pre arranged position to cover an emergency involving another aircraft with a suspected undercarriage malfunction. As 'OW' taxied, the cockpit transparencies were still heavily misted and the Direct View (DV) window was seen to be open. At 1133 hrs the instructor reported that he was 'ready' but was told to hold. At 1135 hrs 'OW' was cleared to line-up Runway 26 and informed by ATC that sleet and snow showers had been reported by another aircraft to be moving in from the west. The weather at the airfield at 1133 hrs was, surface wind of 060°/06 kt, visibility 25 km, slight rain, overcast at 2,000 feet, temperature +4°C and dew point +3°C. Take off clearance was granted at 1136 hrs.

The aircraft lined up on Runway 26 and remained stationary for some 26 seconds. The flaps were in the retracted position in accordance with the normal club procedures and the DV window appeared to be closed. There was still some misting of the windscreen but the level of reduction in external visibility could not be determined. Engine power was smoothly increased and the aircraft accelerated along the runway. Propeller RPM was calculated as 2,460 RPM, which was normal for the aircraft, as it passed abeam the video camera. The rear passenger appeared to be either waving or cleaning the side window with the sleeve of his left arm with some misting of the transparencies still visible.

The aircraft became airborne after a ground run of 512 metres, initially adopting a gentle climb with the nose pitching up to a steeper than normal climbing attitude. At about 350 feet above the runway the aircraft levelled and commenced a left turn. An experienced PA28 instructor, who was travelling west on the road which runs along the south side of the airport, watched the aircraft turn towards him at an estimated height of 200 to 300 feet with the angle of bank increasing and yawing from side to side. The aircraft started to descend as it passed him, the angle of left bank increased to some 45°, and it then struck the ground with the port wing followed by the nose of the aircraft. Witnesses observed a cloud of fuel spray from a ruptured fuel tank. Assessing the developing situation, the tower controller instructed the fire appliance positioned on Runway 35 south of the intersection with Runway 26 to clear the runway for 'OW' but the aircraft crashed before the appliance could move. The controller then alerted the RFFS to the accident advising them that there were two persons on board as per the booking out sheet. The fire service attended immediately and removed from the wreckage the three persons who had all received fatal injuries in the non-survivable impact.

Medical and pathology

Post-mortem examination of all three persons showed no evidence of any disease, drugs or substances which might have caused or contributed to the accident.

Aircraft description

The aircraft was a Piper PA-28-140 Cherokee, which is a low winged four seat all metal monoplane with a fixed tri-cycle landing gear. It had been built in 1967, since when it had flown for a total time of some 9,500 hours. It was fitted with a normally aspirated 140 hp four cylinder piston engine driving a fixed pitch two bladed propeller. The aircraft was fitted with dual controls to enable it to be flown from either front seat position, but a full instrument panel was installed only on the left front seat position of the aircraft. In particular, the Air Speed Indicator (ASI) was located at the upper left side of the panel, which from the right seated position meant that it was not readily in the pilot's normal field of view.

This aircraft differed from the PA-28 Warrior, upon which the pilot had trained in order to gain his instructor's rating, in several relevant ways. The pitch trim control of the Warrior is located on the floor beneath the throttle, not in the roof as in the PA-28-140 model. The wing has a different plan form, and hence slight but significant differences in performance and handling when compared to the Warrior, which has a more powerful engine.

The aircraft's documentation was found to be in order. The aircraft possessed a current Certificate of Airworthiness, which was due to expire on 3 August 2000. The last recorded maintenance, an annual check, had been completed on 14 December 1999, some 4 days and 2 flying hours prior to the accident.

Impact parameters

The aircraft crashed onto an area of grass covered ground immediately to the north of taxiway Alpha at a position almost due south of the aerodrome reference point. It had struck the surface in a steep nose down and left wing low attitude at a moderate speed, which precipitated severe structural damage to the cockpit area and left wing. Analysis of the wreckage at the accident site, and later the AAIB at Farnborough, showed that the propeller had been rotating at the time but it was not under high power. The flaps were retracted, and that the aircraft had been complete and structurally intact. Although the left wing fuel tank had been ruptured, there was no fire.

Wreckage examination

The engine and its related systems were examined in some detail, but this did not reveal any pre-accident defects or failures. The engine could still be turned and retained good compression on all four cylinders. All ancillary equipment either could be functioned (eg, magnetos, fuel pumps) or showed no evidence of pre-accident defect (eg, carburettor). Of note, it was established that the carburettor air heat control had been trapped in the 'cold' position by impact deformation of the control cable and, similarly, that the throttle control was set for maximum power.

All the flying control systems were examined with no evidence of any pre-impact failures or defects being revealed. In this, early, model of PA-28 the stabiliser trim control is mounted in the roof of the cockpit and takes the form of a older car type of window-winder handle which rotates in a horizontal plane, adjacent to which is a pointer and a simple graduated scale. This handle is connected by cables to a screw jack mechanism in the rear of the fuselage which operates on the stabiliser anti-balance tab to effect pitch trim. The nature of this arrangement, and the relatively

intact nature of the rear fuselage, made it unlikely that the trim screw had changed position as a result of the impact or during the rescue operation by the RFFS, and care was taken during the recovery to avoid pulling on either trim cable. When this 'as-found' trim position was subsequently set up on an identical aircraft, it was established that it was positioned at some 65% nose up trim from neutral at the time of the accident. In addition, it was evident that the swivelling knob on the end of the handle was missing. Examination revealed that its absence had not resulted from the impact, but that it had been missing for an extended period, and thus would have made trimming a more difficult, but not an impossible, operation. The absence of this knob for a period of time was subsequently confirmed by an instructor/pilot who had been familiar with this particular aircraft.

The Air Speed Indicator (ASI) had survived the impact intact, but the pointer was displaced by some 20° to the right from its at rest position. The results of a calibration of this instrument suggested that if the pointer displacement was assumed to have occurred during the accident, then it should have indicated the aircraft's speed within the normal limits of accuracy. This instrument was of a type commonly found in light aircraft of US origin, in that the fascia was calibrated in MPH in large digits around the outer section of the dial, whilst a concentric smaller scale, calibrated in Knots, was also present. In addition, two segments of the dial were present where, using a small knob, pressure altitude may be set against a temperature scale to enable a reading of True Air Speed. This results in a somewhat cluttered presentation of the instrument's reading. This ASI is shown in Figure 1, viewed normal to the face. Again, using an identical aircraft, an assessment of the limited visibility of this instrument face was made, when viewed from the right front seat, taking into account the likely seat position on the accident flight and the stature of the instructor, and this is shown in Figure 2. Enquires made of the organisation which trained the pilot/instructor for his instructor's rating revealed that all the Piper Warrior aircraft in the fleet were equipped with ASIs which displayed a single scale calibrated in Knots.

The aircraft was fitted with a stall warning system, comprising an airflow sensing vane, fitted to the leading edge of the left wing, and a red warning light located close to the centre of the left instrument panel. Examination of the filament of the warning light revealed that at impact the light was not illuminated. The nature of the impact suggested that evidence of illumination was likely to have occurred should the filament have been hot. The micro-switch attached to the stall warning vane was serviceable but its setting in relation to the wing leading edge had been disturbed in the accident.

Discussion

A number of factors may have contributed to the accident, either individually or in combination. They include:

The instructor's experience

The instructor commenced flying training on a CAA approved 509 course on 29 May 1995 and flew 32 hours dual and 26 hours P1 on the PA28 before the flying school ceased trading. His last flight at that organisation was recorded on 30 October 1995. Following a break from flying of 33 months he started another CAA approved 509 course with a flying training organisation based at Bournemouth on 27 July 1998 and flew 44 hours dual and 65 hours P1 on the PA 28. He was granted a CAA Commercial Pilots Licence without Instrument Rating on 23 August 1999.

On 7 September 1999 he attended a Flying Instructor course at Manston, Kent and flew 35 hours dual and 5 hours P1 on Cessna 152 aircraft, passing the flight test on 12 October 1999. The flying instructor rating for single engine landplanes was issued on 23 October 1999.

On 23 November 1999 the pilot was accepted on a probationary basis by a flying club to carry out flying instruction. The CFI placed him with two club members, one who held a PPL and the other who was in the process of obtaining one, and asked them to assess him to see if he would fit in to the club environment. The instructor carried out a total of 4 hours P1 in seven flights on the Cessna 150 up to the 10 December 1999, during which he handled the aircraft briefly only on one occasion. Whilst the pilot did receive briefings on various club matters no formal check flight or assessment of his instructional or flying ability was required or carried out.

The accident flight was the first occasion that the pilot had flown the PA28 Cherokee, all his previous flying was on the PA28 Warrior.

Weight and balance

The aircraft all up weight at taxi was 2,075 lb. This was 75 lb below the maximum permitted all up weight of 2,150 lb. The C of G was 88.71 inches aft of the datum which at the take-off weight was just aft of the forward C of G limit but within the aircraft C of G operating envelope. The elevator trim position recorded from the aircraft after the accident was 65% nose up. This was possibly due to the trim not being reset following the previous landing. In this configuration there would have been no significant handling problems. However, failure to maintain forward pressure on the control column, whilst perhaps concentrating on other matters, would have resulted in a positive nose up pitching moment.

Misted transparencies

The previously mentioned video showed the aircraft transparencies were distinctly misted during the taxi phase. The DV window was open and if the demister was being used a degree of clearance would have taken place. The demister on this model of aircraft is not very effective at idle engine power or on the ground, there being no fan assistance. No cloth was found in the aircraft, although wiping with the hand or a piece of clothing would have helped to a limited degree. During the take-off run, the side windows are seen to be clear, the DV window is closed and the rear seat passenger appears to be either waving or wiping the left rear window with his left arm. It was not possible from the video to establish if the front windscreen still had condensation on it. The student and passenger both had cameras with them, but the camera backs had opened on impact and no photographs were recovered.

Carburettor icing

The temperature was +4°C and the dew point was +3°C. This constitutes the highest risk area for susceptibility to carburettor icing. On the morning of the accident there were a number of reports from other pilots of carburettor icing, describing in particular the speed with which it occurred and also the severity. Two witnesses heard the engine of the accident aircraft running from take off to the point of impact with no discernible change in note, although one witness thought it was quieter than normal.

Stall warning

The pilot was used to having both an audio and visual warning. Given that his full attention was focused on flying the aircraft or trying to resolve a reduction of engine power, an audio warning would have alerted the pilot to a dangerously low air speed irrespective of where he was looking. In order to see the light he would have had to be looking across the cockpit in that general direction. Although the light shows no sign of being illuminated at impact it is possible that enough airspeed was recovered in the descent to cause it to extinguish had the aircraft dropped the left wing at the stall. Experienced instructors who had used 'OW' for instructor training noted its tendency to drop a wing at the stall, which would have been more marked in the turn and with the yawing and rolling motion described by the instructor witness.

Conclusions

Given that the engineering investigation found no technical reason for the accident the factors set out in the discussion of the report were considered with their possible effects.

The take-off run was approximately 1,680 feet (512 metres), although the exact point at which the take-off run commenced could not be established. The flight manual, with a 5 kt tail wind component, requires a run of 1,110 feet (339 metres). The speed at lift off should have been 73 mph (63 kt) but the actual speed could not be accurately assessed. However, a runway marking permitted a coarse estimation of 72 mph ground speed just prior to lift off.

The low height at which the aircraft ceased climbing and made the left turn suggests that the pilot had encountered a situation, which required him to level off. The absence of any radio call suggests that he probably had a high workload. The most likely reason for the level off would have been a reduction in engine power due to carburettor icing. The carburettor heat control was found in the 'cold' position. When the temperature and dew point conditions are associated with the length of time holding before take off, and the severe carburettor icing suffered by other pilots that morning, the probability of this occurring was very high.

Whilst the side windows were clear the windscreen had a slightly opaque appearance as if still misted. The aircraft appeared to maintain good runway alignment and therefore the possible lack of forward visibility was discounted as a major contributory factor.

At the point of level off there would have been limited runway available to land ahead and, given the more built up area to the north of Runway 26, a left hand circuit to return might have seemed the better option if an engine problem was apparent. The pilot had no experience of turning at such a low level and the natural inclination to try and maintain height, combined with a reduction in engine power, would have resulted in his trading airspeed for height. The nose up elevator trim setting possibly aggravated this. In these circumstances the airspeed would have decayed in the turn.

The limited amount of actual aircraft handling by the instructor in the preceding weeks, and the position of the ASI in relation to his field of view, would have made accurate speed holding under the circumstances very difficult.

The eyewitness, a flying instructor who observed the final moments of the flight, described the aircraft's manoeuvre as a 'wing drop at the stall'. It is not clear if the aircraft nose dropped as a result of the pilot attempting to recover airspeed or as a result of the aircraft entering an incipient spin. However, insufficient height was available for recovery from the manoeuvre.

Safety recommendations

It is recommended that:

Recommendation 2000-23

At the time of the renewal of an aircraft's Certificate of Airworthiness for Transport Category (Passenger), the CAA should ensure that the type of ASI(s) fitted does not have multiple scale indications. Furthermore, an ASI should be so positioned that it is easily viewed from any pilot position from which the aircraft is normally flown.

Recommendation 2000-24

The CAA should recommend to Registered Facilities (RF) that newly appointed instructors undertake a flight with the Chief Flying Instructor, or other nominated person, to confirm the instructor's instructional and flying ability. If the RF operates a class or type of aeroplane not covered by the experience of the newly appointed instructor, specific differences should be identified to the instructor and the differences training recorded in his/her logbook.