

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-BMXL	
No & Type of Engines:	1 Lycoming O-235-L2C piston engine	
Category:	1.3	
Year of Manufacture:	1980	
Date & Time (UTC):	31 May 2005 at 1942 hrs	
Location:	Farm strip near Chepstow, Monmouthshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Substantial	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	50 years	
Commander's Flying Experience:	104 hours (of which 4 were on type) Last 90 days - 5 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot, aircraft inspection, site inspection and further AAIB enquiries	

History of the flight

The pilot and his passenger were both members of a group which owned the aircraft. They were in the process of conducting an aerial inspection of a newly prepared farm strip prior to its later use by the passenger, using the same aircraft. The pilot reported that the aircraft had departed from Wycombe Air Park at 1810 hrs, and that the flight was expected to terminate at Wycombe once the inspection was complete. The aircraft had been refuelled after a previous flight; prior to departure the fuel load was checked visually and seen to be at a level approximately equivalent to 76 to 78 litres. Total fuel capacity was 121 litres. Once at the farm strip the

aircraft flew two visual circuits, each to a low go-around, which were flown by the passenger from the right hand seat. The pilot took control for a third circuit, intended to be the last before returning to Wycombe. However, as the pilot applied full power to go-around, the engine began to run roughly. The pilot sensed a reduction in power, though he noted that the engine was producing maximum rpm. As a precaution, he reduced power and carried out a landing on the farm strip. The landing was uneventful, with no further abnormal engine indications or unusual throttle position; the engine idled normally prior to shutdown. The pilot reported that he had been

using carburettor heat regularly during the flight and did not associate the fault with induction system icing. He also stated that he had changed fuel tanks at least twice during the flight.

The pilot inspected the engine and aircraft, and although there was a slight oil quantity anomaly that was attributed to the uneven ground, no faults were apparent. The pilot and his passenger then prepared to depart from the strip. Flaps were set to one notch, which is the procedure recommended in the Pilot's Operating Handbook (POH) for a soft or short field takeoff. As the aircraft taxied to the take-off point the pilot conducted two power checks, and again conducted a power check immediately before commencing the take-off roll. Carburettor heat was used in accordance with the procedures for the type. Engine indications were normal and the aircraft seemed to accelerate normally down the strip, which initially had a marked down slope in the direction of takeoff. As the aircraft neared the bottom of the slope prior to the final upward sloping section of the strip, the aircraft achieved 55 to 60 kt and became airborne normally in response to slight backwards pressure on the control stick. However, the engine immediately began to run rough again and the pilot sensed a sink developing. He waited a moment before initiating a further backward movement of the stick, but the apparent loss of power persisted and the aircraft sank back again. The pilot aborted the take-off attempt and closed the throttle. The aircraft landed heavily on the upward sloping part of the strip, and bounced at least once. It then passed through the boundary fence into the field beyond, where it collided with a calf which later had to be destroyed. The pilot recalled that the propeller was turning when the aircraft passed through the fence, but that it had stopped by the time the aircraft came to a stop. The pilot carried out a normal sequence of shut-down checks, including raising the flaps, and the two occupants vacated the aircraft by

both doors. The aircraft had suffered substantial damage and was later written off.

Aircraft inspection

Photographic evidence taken within 48 hours of the accident was available, as was information from the specialist recovery organisation. The aircraft came to rest upright, with the left main gear missing and the left wing in contact with the ground. The aircraft was heading about 30° to the left of the take-off heading, and was situated 130 m beyond the fence marking the end of the strip. Witnesses from the recovery organisation noted a lack of obvious ground marks.

The aircraft was returned to the group's maintenance organisation at Wycombe Air Park, where it was subsequently examined by the AAIB. Both wings had suffered substantial damage to the leading edges, the worst occurring to the left wing at its outboard end. The left wing tip showed an abrasion pattern and scoring on its rear underside and the rear most section of the tip had detached. The right wing suffered less severe damage, which included a cracked wing tip assembly and damage to the outboard aileron. Both wing skins were buckled, though the majority of the upper skin damage is believed to have been caused by cattle which occupied the field whilst the aircraft was awaiting recovery. The left main undercarriage assembly had detached from the wing as a result of two retaining bolts failing. At the rear of the fuselage there was a cracked frame at the base of the fin, deforming the outer skin and indicative of a heavy load transmitted through the tail skid.

The centre 'carry through' spar, which incorporated the rear wing spar attachment points was buckled where it passed through the fuselage. The port tail plane had a large hole in both upper and lower skins at approximately mid span, just aft of the leading edge. One propeller blade

was bent backwards about 20° from about mid-span, whilst the other blade was undamaged. Apart from two very small burrs on the extreme propeller tip, and one witness mark centrally on the damaged blade face, there were no other scratches or score marks on either blade. Both flaps exhibited minor buckling. There were no obvious signs of the reported engine problems. Spark plugs were removed and showed no signs of sooting or fouling. Fuel was present in the aircraft and at the engine; 69 litres were drained from the tanks prior to recovery.

The aircraft had been subject to a number of verbal reports from group members concerning an intermittently rough running engine, though there was no factual data to support this since no related defect had been raised. The aircraft's maintenance company had a long association with the aircraft dating back to when it had been a club aircraft. There was no recorded history of engine problems on this aircraft, and the company was unaware of the reports concerning an intermittently rough running engine, having been neither asked to investigate the reports nor asked for advice or opinion on the matter. The reports themselves varied from occasional mis-firing to rough running similar to that associated with carburettor icing, or to excessive 'mag drops' during power checks which were cleared prior to takeoff. As far as was ascertained, the reports of rough running were confined to less experienced members of the group.

The farm strip

The strip had recently been prepared for use by the land owner in liaison with the passenger of the accident aircraft with whom he was acquainted. The strip spanned parts of three fields which were in use for cattle grazing. In preparing the strip, parts of two tree lines which separated the fields had been removed. The ground was then filled and lightweight electric cattle fencing installed. The

surface of the strip had not received special attention and was generally rough or very rough in areas. Some isolated trees had been removed, leaving uneven ground and small rocks in places.

The strip was orientated 07/25, with a main take-off direction of 066°(M), though the initial part of the take-off run had a direction of 085°(M). When the aircraft landed, it did so in a westerly direction on the central field with both fences rigged, giving a landing strip length of 315 m. For the takeoff, which was to the east, the westerly fence was lowered, giving an available strip length of 495 m. The easterly field, in which the aircraft came to rest, could be made available for use but held cattle at the time of the accident.

The strip was situated on undulating ground. From the take-off point the ground had a significant downward slope for about 350 m before sloping upwards to the end fence. The ground then sloped away once again in the 'over-run' field. The ends of the strip were approximately level and there was a gradual fall in the ground from left to right when viewed in the direction of takeoff used.

The westerly field from where the takeoff commenced contained a number of large trees which dictated the slightly angled initial take-off run. The main field was bounded by a tree line to the north (left side, in the direction of takeoff), with isolated trees to the south where the ground started to fall away. The 'over-run' field was bounded on all sides by trees, but only those on the south side were adjacent to any likely aircraft manoeuvres. The strip width was approximately 50 m, being established by the gaps in the tree lines where trees had been removed. Mean field elevation was 475 ft amsl.

Pilot experience

The pilot, with 104 total flying hours, had learnt to fly on Warrior aircraft and had recently converted to the PA-38 to enable him to fly the group's aircraft. He reported that he had experienced some strip operations whilst flying in the USA but had not undergone formal training and none of this flying had been recorded. The passenger had about 160 hours total fixed wing time, with an additional 60 hours rotary wing. The passenger's recent flying had mostly been rotary wing with limited recent fixed wing experience. Prior to the accident flight neither pilot had met nor flown with each other and each had only a broad idea of the other's experience.

The passenger, intending to fly to the strip himself in the same aircraft, had originally intended to visit the strip with either a flying instructor known to the group, or the group's leader who was an experienced Tomahawk pilot. On the day of the flight he had tried to book the aircraft, but when it was clear that it had already been booked, he approached the pilot, whom he did not then know, to see if he could fly with him. The pilot agreed, and agreed to visit the strip area with a view to conducting an aerial inspection of the site and to take some photographs.

Witness information

The land owner said that he had spoken with the aircraft passenger on the afternoon of the flight and been told that a landing was planned if all appeared well. He saw the aircraft land, and noted that it stopped comfortably within the length of the centre field. Both crew men appeared relaxed, and he did not recall either mentioning that there had been any aircraft problems. He could not recall the crew carrying out a protracted inspection of the aircraft.

The land owner and his wife observed parts of the take-off, but not the final seconds of the flight. The aircraft was seen to accelerate down the initial part of the

strip, and to get airborne before the down hill part of the strip ended - a distance of about 300 to 325 m. However, at about 25 to 30 ft the aircraft was seen to roll to the left and it was clear that all was not well. The aircraft was then seen to "veer" from the left to the right, though it is not known how much the aircraft deviated from the strip centre-line. Neither witness heard unusual engine noises or saw the aircraft strike the ground.

Meteorological information

En-route to the farm strip, the pilot obtained a weather report from RAF Brize Norton, which reported calm conditions, good visibility and no significant cloud. The conditions in the accident area were observed to be very similar, with a negligible surface wind. Information from the Met Office shows that the 2,000 ft gradient wind over the Chepstow area at the time of the accident was approximately 280°(T) at 5 to 10 kt. This suggests a general surface wind in the same area of approximately 250° at 5 kt. The temperature and dew point in the area at the time were approximately +13°C and +09°C giving a relative humidity of 77% and a 'serious' risk of carburettor icing at all power settings.

Aircraft performance

The aircraft was subject to a maximum take-off mass of 757 kg. The pilot and passenger weighed a combined total of 162 kg, including an allowance for clothing and equipment. The 69 litres of fuel drained from the aircraft weighed 49 kg, giving a total payload of 211 kg. With a basic mass of 546 kg, the aircraft's take-off mass at the start of the take-off roll is estimated to have been at the maximum allowed.

Sources of information available to pilots to calculate takeoff and landing performance include among others; the aircraft's POH, the CAA's General Aviation Safety Sense leaflet 7b '*Aircraft Performance*' and Aeronautical

Information Circular 67/2002 '*Take-off, climb and landing performance of light aeroplanes*'. Neither the pilot nor his passenger knew accurate distances available at the strip for takeoff and landing, nor had they made any performance calculations for the strip. The pilot believed a safe takeoff would be assured, based on his experience of the airplane's performance from the 695 m grass runway at Wycombe Air Park.

Performance data is produced in the POH for the PA-38 at maximum mass of 757 kg. Data is given only for operations from paved level dry runways and represents the performance achieved with a new aircraft and engine, in ideal conditions and flown by a highly experienced pilot. The data is not factored to include any safety margins.

Utilising this data the take-off ground roll with one notch of flap, lifting off at 53 kt, is 245 m. For a 5 kt tailwind, the take-off roll increases to 317 m. The above figures require adjustment for the actual conditions. The CAA states in its leaflet General Aviation Safety Sense 7B - '*Aeroplane Performance*' that a factor of 20% should be added for dry grass. Rough ground is not considered as such, since it is presumed that the strip is prepared to a minimum standard in this respect. Applying the factor for grass, the take-off ground roll increases to 294 m in still air and 380 m with a 5 kt tailwind.

Whereas public transport flights are legally required to apply specified safety factors to performance data, private flights are not. However, the CAA states in its leaflet General Aviation Safety Sense 7B - '*Aeroplane Performance*' that it is '*strongly recommended*' that private flights apply the same factorisation as applicable to public transport flights. If this factor of 1.33, is applied, the take-off roll is increased to 391 m in still air and 505 m in a 5 kt tailwind. The available strip length was 495 m. The effect of down slope for takeoff is not normally considered.

Discussion

As well as the accident sequence itself, the investigation was concerned with how an inexperienced pilot with no recorded strip training found himself operating from a new and unproven farm strip in an aircraft at maximum allowed mass, with no prior preparation and with doubts over the engine's reliability.

For the pilot, the visit to the strip was a change of plan. A key factor is whether or not a landing at the strip was raised by the passenger prior to the flight. Were it not, as the pilot and passenger reported, then there would be no reason for the pilot to raise any concerns or to seek more information about the strip, other than its location. The passenger stated that his original intention was to fly to the strip that evening with a more experienced pilot, in which case a landing was a possibility, and he believes it may have been with this in mind that he mentioned the possibility of a landing to the strip owner. However, the strip owner thought the conversation had taken place that afternoon only a short while before the flight. Given the passenger's intention to use the strip and his status as a full group member, it is surprising that he was not in possession of accurate data or performance information for the strip.

Reports of the engine rough running and power loss prior to landing were not sufficiently detailed to point to a possible cause. No mechanical reason was found, though conditions were conducive to carburettor icing. The pilot reported that he had made normal use of carburettor heat during the flight and that his normal fuel management had included changing tanks twice during the flight from Wycombe. Given that the aircraft was positioned on short finals, the decision to land appears reasonable. However, this must be weighed against the destabilising effect of selecting full power to go-around,

the inevitable time delay to recognise the problem, the time to make a decision and the mental re-adjustment that would be necessary. Given that the go-around was initiated from a relatively low height, these effects would tend to cause the aircraft to land beyond the ideal touchdown point, with an increased risk of over-running the available strip length.

It is to the pilot's credit that he was able to carry out a successful precautionary landing from a critical position into the restricted field. Although the aircraft had already flown two approaches, this was the pilot's first approach as handling pilot. However, having landed successfully, it could be expected that the pilot would then seek to establish the cause of the rough running and power loss. Apart from the inspection of the aircraft and engine, no detailed investigation was carried out and no advice was sought. It is surprising therefore that both pilot and passenger subsequently boarded the aircraft for takeoff just a short time later.

The condition of the strip was very poor in places and could have caused handling difficulties as well as adversely affecting take-off performance. It is difficult to quantify the latter, and to some extent the adverse effect on performance would have been offset by the significant down hill slope on the take-off portion of the strip. The pilot's account of the takeoff and eye witness information indicates that the aircraft became airborne after a ground roll of about 300 to 325 m, which is not markedly beyond that expected on a grass strip.

The final position of the aircraft was some 300 to 325 m beyond the point at which it was believed to have become airborne - about the same distance as the take-off roll. Had the aircraft lost power and touched down immediately after taking off, it would not have had the energy to cover this distance, particularly as part

was uphill. Furthermore, the passenger recalled that the aircraft stopped very quickly after it had touched down. Moreover, the aircraft would not have run straight for this distance if, as the pilot believed, the left main undercarriage had detached at this point and the left wing had contacted the ground.

Similarly, the extensive damage suffered by the aircraft was difficult to reconcile with the reported occurrence. Abrasion damage and score marks to the underside of the left wing tip indicates that it contacted the ground at a relatively high forward speed. Although this is presumably connected with the loss of the left undercarriage, the possibility remains that it could have occurred on takeoff. The right wing also contacted the ground at some stage, and damage to the right aileron suggests that it was deflected downwards in a 'roll left' sense at the time. Additionally, the left wing was subject to a rearwards and upwards force sufficient to buckle the centre 'carry through' spar. The pilot's recollection that the aircraft landed heavily in a nose up attitude on its main wheels is supported by the damage to the aft structure and the limited damage to the nose gear, which was subject to a rearwards force but did not collapse. The damage to the tail could have been caused by the left main undercarriage leg puncturing the tailplane, though there were no signs of paint or marks on the leg to corroborate this. The main damage to the propeller was to one blade only, and not associated with rotation. Apart from the very small burrs on one tip, there was no evidence that the propeller had struck the ground. One possible reason for the blade bend could have been the collision with the cow, but the pilot believed that it was struck by the right wing.

A further discrepancy concerned the fuel state. A total of 69 litres was drained from the aircraft, though the expected fuel on board should have been between 45 and 55 litres. This discrepancy remained unexplained.

Eye-witness information suggests that the aircraft became airborne in a recognisable manner and that the pilot appeared to be experiencing some difficulty with control. Given the rough surface and the chance of encountering an unexpected tailwind, it is possible that the aircraft became airborne at an abnormally slow airspeed. The POH techniques call for acceleration immediately after lift off towards the best angle or best rate of climb speed, as applicable. The significant upslope ahead of the aircraft may have caused the pilot to inadvertently maintain too high a nose attitude to allow this to happen. Combined with the possible low or reducing airspeed and the probability of climbing into a light tailwind, a scenario can be envisaged which includes both the sink felt by the pilot and the apparent erratic flight path described by witnesses. Any loss of power at this stage, which could conceivably be due to carburettor icing, would have made a successful recovery from the situation unlikely.

Summary

The reported engine problems which necessitated the precautionary landing and preceded the accident could not be accounted for, though conditions were conducive to carburettor icing. The pilot then attempted to takeoff from an unfamiliar strip, which was poorly prepared and for which he had no accurate performance information, and with an engine whose performance had already precipitated the precautionary landing. The damage to the aircraft, its final resting place and eye-witness accounts were inconsistent with the pilot's account of the accident and suggested that the aircraft had been airborne for longer than the pilot recalled. The rough ground, the slope of the strip and probable light tailwind component during or immediately after lift off may have contributed to the accident.