ACCIDENT

Aircraft Type and Registration:	Piper PA-32RT-300 Cherokee Lance II, G-RHHT
No & Type of Engines:	1 Lycoming IO-540-K1G5D piston engine
Year of Manufacture:	1978
Date & Time (UTC):	3 June 2011 at 1243 hrs
Location:	Wycombe Air Park, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 4
Injuries:	Crew - 1 (Minor) Passengers - 4 (Minor)
Nature of Damage:	Left wing severed, right wing attachment, stabilator and propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	195 hours (of which 57 were on type) Last 90 days - 14 hours Last 28 days - 14 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft struck a hedge at the aerodrome boundary during an attempted takeoff. Its weight and centre of gravity (CG) were outside the flight envelope, and the runway length was marginal for takeoff. These factors probably combined to cause the pilot to over-control the aircraft in pitch resulting in the aircraft failing to gain height after takeoff.

History of the flight

The pilot had flown the aircraft with one passenger from its base at Sywell, Northampton to Wycombe Air Park with the intention of picking up three more passengers and flying to the Isle of Man (IOM). On arrival at Wycombe Air Park, the pilot consulted with the pilot of another aircraft flying to IOM and filed a VFR flight plan to Ronaldsway. The accident aircraft was refuelled to 60 USG. The pilot met his three passengers by the aircraft and loaded their overnight bags with his own in the rear baggage compartment. The passengers then boarded the aircraft and the passenger who had accompanied the pilot from Sywell re-boarded in the front right seat. One passenger sat in a mid-row seat which was rear-facing and the other two passengers sat in the two rear seats.

The pilot started the aircraft and taxied to Runway 06 for takeoff, following the other IOM-bound aircraft. The first aircraft took off without incident, although the

ATCO on duty recalled that the aircraft used most of the runway to get airborne. The accident aircraft lined up at the start of Runway 06 and commenced takeoff at 1243 hrs. The pilot used Flap 2, consistent with the short-field takeoff technique for this aircraft. Acceleration on the ground and engine indications appeared normal.

The pilot started to rotate the aircraft at 65 KIAS and, as it became airborne, he realised that it was no longer accelerating or climbing. He recalled that he felt a rumble or buffet and that the aircraft was "wallowing". He checked forward slightly on the control column to keep the aircraft in ground effect but still felt that it would not climb or accelerate. The aircraft then struck a hedge at the boundary of the airfield and came to rest inverted in the field beyond. The front seat passenger and pilot vacated the aircraft through the left window and the other passengers exited through the right door. One passenger required medical treatment for lacerations to his ear.

Witness information

The passenger occupying the right front seat recalled that the takeoff appeared normal until the aircraft rotated. She stated that the aircraft "did not feel right" and that it was not climbing. She remembered looking across at the airspeed indicator and seeing the speed drop from 67 to 60 KIAS. Two of the passengers sitting in the rear part of the aircraft recalled that, immediately after takeoff, a loud "buzzer", later identified as the stall warning horn, sounded and continued to do so until the aircraft struck the hedge[1]. One of the passengers in the rear of the aircraft commented that it seemed to adopt a steep "tail down" attitude just after takeoff and appeared to decelerate.

Two pilots witnessed the crash independently. Both recalled that the aircraft adopted a high nose-up attitude immediately after takeoff. One described the attitude as approximately 30° nose-up. One saw the aircraft "wallowing" in roll and both recalled that, after it reached a maximum height of approximately 4 m, it sank back to the ground in a nose-up attitude before striking the hedge.

Meteorological information

The ATCO recorded the weather at the time of the accident. The surface wind was from 030° at 10 kt, there were few clouds at 3500 ft, temperature was 22° C and QNH 1031 mb. The ATCO had passed a surface wind of 040° at 14 kt when he cleared the aircraft for takeoff.

Aerodrome information

Wycombe Air Park has two runways aligned in the 06 direction, one grass and one asphalt which is designated Runway 06 hard. Runway 06 hard, used by this aircraft, has a declared takeoff run available (TORA) and takeoff distance available (TODA) of 735 m. The boundary hedge, into which the aircraft crashed, is approximately 15 ft high and 789 m from the start of the takeoff run. There is a single-track asphalt perimeter road between the runway and the hedge.

Wreckage and impact information

Physical evidence indicated that the aircraft had passed through the northern boundary hedge of the airfield, close to its eastern end. It came to rest inverted in a cultivated field with the fuselage orientated approximately 90 degrees to the direction of travel. The left wing had separated at the root attachment during impact with the hedge where it remained embedded. The right wing/fuselage joint experienced substantial disruption but the wing remained attached to the fuselage. The left flap

Footnote

[1] The stall warning system is intended to operate within 5 to 10 kt of the stall speed.

came to rest between the left wing and the remainder of the wrecked aircraft. The fuselage, vertical stabilizer and engine mounting sustained relatively light distortion and minimal damage occurred to the engine cowlings. The stabilator suffered substantial damage.

The flap operating lever was found in the second stage (or flap 2) position. The design of the operating mechanism together with the nature of the impact and the aircraft disruption, do not suggest that the lever had moved from its pre-impact position.

Examination of ground markings short of the hedge revealed distinctive linear impressions crossing the perimeter road. Part of the GRP fairing from the rear end of the shallow ventral fin was found nearby.

Examination of the propeller revealed considerable evidence of repeated blade strikes and gross distortion together with leading edge impacts and surface scoring. Removal of the upper engine cowling revealed substantial quantities of cut foliage, similar to that in the hedge, distributed across the top of the engine and lodged between adjacent cylinders. The extent and nature of the propeller damage suggest that the engine was producing high power at the time of the impact with the hedge.

The quantity of hedge material lodged between the cylinders suggested that the propeller airflow drove the foliage into that position. External examination of the engine did not reveal any evidence of mechanical failure. Internal boroscope examination did not reveal any indication of internal damage. All valves and the inertia magneto operated correctly when the propeller was turned.

There was no evidence to indicate other than correct operation of the engine, at high power, at the time of the impact.

The markings observed on the perimeter track and the presence of the fragment of the ventral fin identified close to those markings confirmed that the aircraft was in a tail-down attitude as it approached the hedge, which it struck slightly to the left of the extended centre-line of Runway 06 hard.

Take off performance

The unfactored takeoff distance required by the aircraft, at the all-up weight (AUW) calculated by the pilot and using flap 2, was 655 m. The CAA, in AIC 127/2006 and Safety Sense Leaflet 7, recommends that pilots increase unfactored takeoff distance by 33%; this would have given a takeoff distance required of 871 m; 136 m longer than the declared TODA.

Using the actual aircraft weight, the unfactored takeoff distance required with flap 2 was 731 m, 4 m within the declared TODA.

Weight and balance

The pilot stated that he did not have access to the actual passenger and baggage weights and therefore assumed values for his weight and balance calculation. He calculated a takeoff weight of 3,526 lb and a CG of 95.75 inches behind the datum. Analysis of aircraft weight and balance using the actual weights for the occupants and their baggage produced a takeoff weight of 3,786 lb and a CG of 99.34 inches aft of the datum, exceeding the weight limit by 186 lb, and CG aft limit by 3.34 inches. The CG range and weight chart, overlaid with these points, is shown in Figure 1.

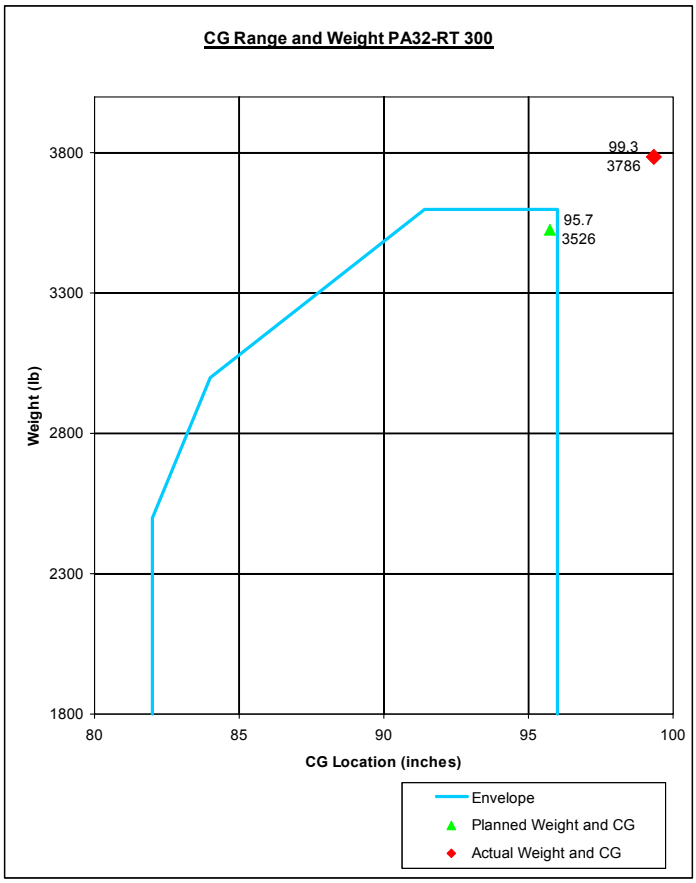

Figure 1,

Flight Envelope

Longitudinal manoeuvre stability

The longitudinal manoeuvre stability of an aircraft relates to the control force and displacement required to achieve a desired pitch rate. Optimum manoeuvre stability ensures that a predictable pull force is required to achieve this pitch rate. Movement of the CG has a very significant influence on the manoeuvre stability of the aircraft and, as the CG moves aft, the stability decreases and the pull force required to achieve the same pitch rate reduces. With reduced manoeuvre stability the aircraft will seem overly sensitive in pitch and the control forces will be unexpectedly light, both of which would adversely affect the ability of a pilot to control an aircraft in pitch accurately. The Pilots' Operating Handbook states:

> *'If the CG is too far aft, the airplane may rotate prematurely on takeoff or tend to pitch up during climb. Longitudinal stability will be reduced.'*

Analysis

Using assumed weights the pilot calculated that the takeoff weight and CG were within limits. Analysis of the weight and CG using actual weights showed that the weight and CG of the aircraft at takeoff were both outside the flight envelope.

The unfactored takeoff distance required was only 4 m less than the distance available. In order to take off in this distance the pilot would have had to employ the correct takeoff technique precisely. By not applying the CAA recommended safety factor, the end of the

runway may have appeared abnormally close to the pilot as he rotated and this proximity may have caused him subconsciously to pull back on the flying controls slightly harder than he intended, in an effort to clear the obstacle.

The CG of the aircraft on takeoff was 3.4 inches aft of the rear CG limit. This CG position would have had a marked effect on the longitudinal manoeuvre stability of the aircraft, which would have been unusually sensitive and light to control in pitch. These handling qualities could cause the pilot to over-control the aircraft in pitch, leading to over rotation on takeoff.

The combination of unexpected handling qualities and runway length limited in relation to takeoff performance probably led the pilot to over-control the aircraft in pitch and adopt a nose up attitude significantly greater than that intended, resulting in a high angle of attack (AOA) and high aerodynamic drag on the airframe. The stall warning horn sounding, the buffet felt by the pilot through the airframe and the wallowing in roll are symptoms of an approaching stall and reinforce the assessment of high AOA.

The high drag generated by the high AOA would have caused the aircraft to decelerate. The scoring on the perimeter road, caused by the ventral fin, indicates that the high nose-up attitude was maintained until impact.

Conclusions

The pilot attempted to take off with the CG of the aircraft located more than 3 inches behind the aft limit, resulting in it having reduced longitudinal manoeuvre stability. This, together with the proximity to the end of the runway, probably lead to the pilot over-controlling in pitch. The consequent abnormally high nose-up attitude and high drag condition meant that recovery was impossible in the field length remaining. The CAA, in AIC 127/2006 and Safety Sense Leaflet 7, recommends factoring takeoff distances by 1.33.