

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Piper PA25 Series 235 G-BCAK
Report on the accident at Wootton, near
Woodstock, Oxfordshire on 25 June 1975

List of Aircraft Accident Reports issued by AIB in 1976

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Department of Trade
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R ODP

28 April 1976

The Rt Honourable Edmund Dell MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr R D Westlake, an Inspector of Accidents, on the circumstances of the accident to Piper PA25 G-BCAK which occurred at Wootton, near Woodstock, Oxfordshire on 25 June 1975.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

**Accidents Investigation Branch
Aircraft Accident Report No. 9/76
(EW/C528)**

Aircraft: Piper PA25 Series 235 G-BCAK
Engine: Lycoming O-540-B2C5
Owner and Operator: Farm Aviation Services Limited
Crew: One pilot - killed
Place of Accident: Wootton, near Woodstock, Oxfordshire
51° 52' 35" N 01° 21' 09" W
Date and Time: 25 June 1975 at approximately 2000 hrs
All times in this report are GMT

Summary

Whilst spraying a field of wheat the aircraft struck a tree in the boundary hedge. After continuing in an easterly direction for a further 106 metres it hit other trees, dived into the ground, turned over and caught fire. The pilot was rescued from the burning aircraft but died later in hospital from chest injuries sustained in the impact with the ground.

It was not possible to determine the extent of the damage the aircraft sustained as a result of hitting the first tree nor the associated effect on the aircraft's performance but the contact with the other trees undoubtedly resulted in a steep pitch-down attitude from which there was insufficient height for the pilot to make a recovery.

1. Investigation

1.1 History of the flight

The aircraft took-off from its base at the disused airfield at Enstone, Oxfordshire at 1940 hrs to spray three fields near the village of Wootton, situated approximately 5 miles southeast of the airfield. Prior to the flight the General Manager of Farm Aviation Services briefed the pilot as to the nature and position of the hazards in the three fields and also drew a sketch map of two of the fields which contained overhead power lines. The pilot said that he knew the position of the hazards in the third field and did not need a sketch of it; he also mentioned that he had previously sprayed the two fields which contained power lines. Although he did not take the sketch map with him, he did have a 1 inch to 1 mile map of the area on which the fields and the power lines had been marked.

The first field which the pilot sprayed was situated just to the north of Wootton and it is estimated that he would have used about one half of the aircraft's original hopper load of 83 gallons of pesticide on that field. He then flew direct to the second field, approximately 400 metres to the east. Accordingly to eyewitness evidence he did not make any preliminary reconnaissance circuit but immediately commenced spraying while descending very steeply over high trees bordering the western edge of the field. The aircraft was then seen flying at an estimated height of about 6 feet above the ground towards the eastern end and according to the pilot's Managing Director would probably have been flying at a speed of about 105 mph. The only eyewitness to events at that end of the field saw it flying level but steeply banked and partly hidden by trees. A twin power line, running roughly north to south about 30 feet above ground level, is positioned about 22 metres before a very substantial hedge which forms the eastern boundary of the field and separates it from the next field which was also to be sprayed. A number of trees, some of them extending to more than 30 feet, grow in this hedge. There were no indications that the aircraft had touched the power cables but there was evidence that it had struck the top of one of the trees whilst in a steep left bank and that part of the spray boom equipment under the left wing had been torn off as it passed through the upper branches. The aircraft continued in an easterly direction across the next field for approximately 106 metres and then hit other trees in a hedge which borders the B 4027 road. It then dived onto the road in a very steep nose down attitude and turned over into the hedge on the other side of the road, demolishing a telegraph pole at the road side. The aircraft then caught fire. The noise of the aircraft striking the trees and the road was heard by a number of witnesses and two of these, who were about 230 metres along the road from the accident site, indicated that just before they heard the crash the engine was at very high power.

The pilot was rescued from the burning wreckage but died later in hospital.

1.2 Injuries to persons

| Injuries | Crew | Passengers | Others |
|-----------|------|------------|--------|
| Fatal | 1 | - | - |
| Non-fatal | - | - | - |
| None | - | - | - |

1.3 Damage to aircraft

The aircraft was destroyed by impact and ground fire

1.4 Other damage

There was damage to the trees struck by the aircraft and a telegraph pole at the edge of the B 4027 road was destroyed. There was also fire damage to a hedge in the vicinity of the crash site

1.5 Crew information

Pilot: Aged 31

Licence: New Zealand Commercial Pilot's Licence, valid until 10 April 1976. The licence had been validated by the Civil Aviation Authority (CAA) from 25 April 1975 to 24 October 1975 for PA 25 aircraft operated under contract to Farm Aviation Services Limited.

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|---|---|
| Ratings: | Aircraft type ratings; PA24, PA25, Cessna 180, PL12, DHC2. Chemical rating; valid to currency of licence. |
| Last medical examination: | 10 April 1975 (New Zealand), assessed fit. |
| Total pilot hours: | 5,421 hours. |
| Total flying hours in command of PA25 aircraft: | At least 920 hours. |
| Total flying hours in last 28 days: | 72 hours 10 minutes. |
| Rest period: | 13 hours 20 minutes, before commencing duty at 0820 hrs on the day of the accident. |

The pilot commenced flying in New Zealand in February 1962 and obtained a Commercial Pilot's Licence in December 1964. He completed a course as an agricultural pilot in February 1965, during which he received 30 hours of flying training and commenced crop spraying operations in New Zealand the following month. Since that time he had flown regularly as a crop spraying pilot and had operated in Australia, South Africa, the Sudan and the United Kingdom as well as in New Zealand.

He first flew in the United Kingdom in the summer of 1972 and again in the summer of 1973, on both occasions with Farm Aviation Services Limited, who formed a high regard for his professional ability as a crop spraying pilot. In April 1975 he again commenced operations in the United Kingdom with Farm Aviation Services Limited and it has been established that since that date he had twice sprayed the field where the accident occurred.

On the day of the accident he had commenced duty at 0820 hrs at Downham Market in East Anglia after spending the previous night in an hotel there. He returned to Enstone at 1745 hrs after completing a total of 4 hours 25 minutes flying time, which included both spraying and ferrying. He then flew locally for one hour on a spraying detail before taking off on the accident flight at 1940 hrs.

1.6 Aircraft information

The Piper PA25-235 Pawnee is a single seat, single engine low wing monoplane specifically designed for agricultural operations, in particular, crop spraying. It has a well designed cockpit canopy which allows an extremely good field of view to the front and on both sides of the aircraft. A 120 gallon capacity hopper, an integral part of the aircraft, is fitted between the cockpit and the fuel tank (35 gallon capacity), which in its turn is fitted immediately aft of the engine fire wall. The subject aircraft was equipped for liquid spraying and had spray booms fitted just behind the wing trailing edge; they extended from the fuselage to the outer end of the ailerons.

| | |
|-------------------------------|---|
| Manufacturer: | Piper Aircraft Corporation, USA. |
| Date of manufacture: | 1969. |
| Certificate of Registration: | The aircraft was registered in the name of Farm Aviation Services Limited on 24 December 1974. |
| Certificate of Airworthiness: | Special Category (not exceeding 6,000 lb) valid until 20 May 1976. The aircraft had been maintained in accordance with a CAA Approved Maintenance Schedule. |

Total hours since built: 2,706.
Hours since last check: 18.
Total engine hours: 1,534.
Hours since last complete overhaul: 302.
Hours since last inspection: 18.

It has been calculated that at take-off the aircraft's weight was 155 lb below the maximum certificated take-off weight of 2,900 lb and the Centre of Gravity (C of G) was 90.07 inches aft of datum (limits 88.42 inches to 90.30 inches aft of datum). The weight at the time of the accident is estimated to have been 2,303 lb with the same C of G as at take-off.

It is estimated that at take-off the aircraft's fuel tank contained approximately 12 gallons of Avgas 100L fuel and that about 4 gallons would have been consumed prior to the crash.

1.7 Meteorological information

An aftercast prepared by the Meteorological Office gives the following information on the weather within a 5 nautical mile radius of Woodstock, Oxfordshire at 2000 hrs on 25 June 1975:

General situation: A ridge of high pressure was persisting over the area.
Surface wind: Northeasterly at 5 knots.
Visibility: 25 kilometres or more.
Cloud: Nil.
Weather: Nil.
Surface temperature: 19^o centigrade.

The accident occurred in daylight.

1.8 Aids to navigation

Not applicable

1.9 Communications

Not applicable, the aircraft was not fitted with radio

1.10 Aerodrome and ground facilities

Not applicable

1.11 Flight recorder

There was no requirement for a flight recorder and none was fitted.

1.12 Wreckage

1.12.1 *The accident site*

Examination of the trees at the eastern end of the field being sprayed showed that the aircraft had passed through the upper branches of a tree 30 feet high whilst steeply banked to the left and in so doing the spray boom had separated from under the left wing. The steep left bank was confirmed by the swath pattern cut through the tree and by the fact that another tree, immediately to the right of and appreciably higher than the tree struck by the left wing was entirely undamaged. The angle of the swath through the tree was indicative of a trajectory either level or perhaps slightly downward. Subsequently, and whilst in a laterally level attitude, the aircraft struck other trees about 30 feet in height, some 106 metres further on in a direction of 140° (M) and situated along the southwest side of the B4027 road. The aircraft then hit the road surface in a steep nose down attitude and finished on its back in the hedge on the other side of the road, demolishing a telegraph pole at the road side.

Except for two pieces of spray boom from under the left wing which were found close to the first tree, all wreckage was located on and at the side of the B4027 road. The severe impact with the road caused gouging of the surface by the propeller hub and blades. After impact with the ground and telegraph pole the fuel tank ruptured; the subsequent fire which affected the whole aircraft left only the metal skeleton of the fuselage and wing structure.

1.12.2 *Further examination*

As far as possible the aircraft structure was reconstructed and examined. Main impact damage was centred at the front of the fuselage and the left wing root end attachment area. The examination showed no evidence of pre-crash failure or malfunction of the structure and flying controls; all damage was consistent with the crash and except for the separation of the left side spray booms it was not possible to identify damage sustained during impact with the first tree.

The engine was stripped and examined; damage was limited to the forward and after ends. The damage in the forward end was due to impact forces which resulted in the breakage of the propeller shaft and the detachment of the propeller; damage to the after end was caused by very extensive ground fire which also destroyed the fuel lines and the controls of the fuel system. The examination showed no evidence of mechanical failure or malfunction; all damage found was consistent with the crash. In particular the damage to the propeller and the gouging of the road surface showed that the propeller had been rotating under power at the time of impact.

1.13 Medical and pathological information

When he was rescued from the burning aircraft the pilot had no obvious external injuries except burns to his head and shoulders, but he complained of difficulty in breathing. He collapsed in the ambulance and despite intensive resuscitation he died later in hospital.

A full autopsy with histological and toxicological examinations did not demonstrate any medical cause for the accident; death was due to chest injuries. There was no evidence that the organic phosphorus insecticide he was spraying had affected the pilot before or after the accident.

1.14 Fire

There was no in-flight fire. The aircraft caught fire on ground impact, probably as the result of hitting and breaking the telegraph pole at the side of the road; this severely damaged the left forward side of the fuselage and ruptured the fuel tank and the hopper.

The fire, which started in the nose and left wing area and progressed towards the cockpit, varied in intensity probably because the insecticide water mixture in the damaged hopper was leaking out and damping the fire. This gave rescuers time to extricate the trapped pilot, but the fire then spread and eventually consumed the whole aircraft.

Four appliances from the Oxfordshire Fire Service arrived at the scene at 2017 hrs and found the aircraft well alight. They used two high pressure hose reel jets and two 5 lb dry powder extinguishers to extinguish the fire which was accomplished by 2026 hrs. Fourteen fire fighting personnel were in attendance.

1.15 Survival aspects

A number of people were very quickly at the scene of the accident where they found the aircraft on fire and the pilot calling for help. They succeeded in man-handling the aircraft and turning the right wing and fuselage through about 90° to get to him. Three of them crawled into the wreckage, cut the straps of the safety harness and pulled the pilot out of the burning cockpit; by the time this was accomplished parts of the pilot's clothing were smouldering. The pilot, who was obviously badly injured, was carried to the side of the road and cared for by two people who were members of the St Johns Ambulance Brigade, until the ambulance arrived at 2023 hrs and took him to hospital.

Examination showed that although the safety harness had held the pilot in his seat, the seat itself had become detached from its mountings due to general structural deformation of the cockpit during the crash.

1.16 Tests and research

Nil

1.17 Other information

The following extracts are reproduced from the operator's Aerial Application Manual:

'All working sites will be inspected prior to the application task. This inspection will normally be carried out by the Fieldsman from the ground, When such a reconnaissance is being carried out by the Fieldsman and the pilot is in possession of the reconnaissance information, the pilot must also carry out a further reconnaissance either from the ground or the air, prior to the commencement of the task

The reconnaissance must cover the following factors:

I General topography (eg disposition and gradient of hills, or graphic effects on wind etc)

II Flight obstructions (eg cables, trees, masts etc).

The information gathered may be either correlated in the form of a sketch map or in terms of checking the Ordnance Survey map for the area to ensure that there are no omissions or inaccuracies so that the information may be fully obtained under these sub-points from the 1 inch map in the pilot's possession A formal reconnaissance of the working site may be waived if the Company is satisfied that there have been no significant changes since work was last carried out at that site. Visits to up-date the reconnaissance information may be made in part and in such circumstances the pilot will carry out a thorough reconnaissance from the air prior to carrying out the actual task.

Pilots will be provided with information on obstructions for low flying operations. Pilots may not operate without adequate obstruction data The pilot in

command shall be orally briefed as to the nature and position of all cables, pylons and dangerous hazards.

Where possible pilots will wear outer garments to provide the maximum body cover eg flying suits with flame-retardent properties and as a minimum will wear long trousers, long-sleeved shirts and gloves. Such clothing material should not consist of nylon or similar fibres which will adhere to skin when exposed to flame. The company recommends that protective helmets are worn by pilots during low flying operations.

Company pilots will not fly more than 100 hours in any 28 day period. Company pilots will not fly more than 10 flight hours per day. The maximum duty period will be 18 hours defined as from the first take-off from base or operating strip to the time at which the pilot reaches his accommodation, whether to home base or temporary, after completion of duty.'

Note: The Managing Director of the Company stated that it was rare for a pilot to attain 14 hours continuous duty and the Civil Aviation Authority (CAA) has now amended the maximum duty period to 12 hours.

2. Analysis and Conclusions

2.1 Analysis

Although necessarily limited by the very extensive damage sustained, the examination of the aircraft wreckage did not reveal any evidence of pre-crash failure or malfunction of the aircraft, its flying controls, engine or propeller. In particular strip examination showed that at impact the engine had been in excellent operating condition and there was also witness evidence of a considerable power application having been made very shortly before the crash. Consequently it is concluded that, up to the time of striking the first tree, the pre-crash integrity of the aircraft was not in question as a causal factor in the accident.

The pilot was familiar with the field and there had been no significant changes since he had last sprayed it so that a preliminary reconnaissance was not obligatory. Following a steep descent into the field the first part of the spraying run was made at about 6 feet above ground level; this was unnecessary in the prevailing circumstances of weather and terrain since the spraying requirements could have been accomplished quite successfully at the height of the surrounding hedges.

There were no eyewitnesses of the full sequence of events at the eastern end of the field; the one witness of the aircraft's passage through the trees reported that it was steeply banked but longitudinally level. The damage to the trees caused by the left wing, together with the fact that the right wing had cleared an appreciably higher tree, confirms the bank angle as having been of the order of 30° to the left. The swath cut through the trees by the left wing suggests a trajectory which was either level or possibly slightly downward although this trajectory is not necessarily representative of the actual pitch attitude of the aircraft at that moment.

Except for the loss of part of the spray boom equipment from under the left wing it is not possible to define the damage which resulted from the impact with the first tree. Therefore it is impossible to make any useful assessment of the consequential effects on flight performance. It was however sufficient to prevent the pilot from avoiding collision with other trees of approximately the same height some three seconds later (106 metres) along the same general direction of flight. At the time of this second collision although the pilot had been able to level the wings the impact resulted in a severe pitch down and he was much too low to be able to recover.

Throughout his spraying run the pilot would have had a clear view of the eastern hedge immediately ahead of him, the highest point on his line of flight being the tree over which the right wing of the aircraft eventually passed whilst banked to the left. The twin power line, only 22m before the hedge, parallel to it and 30 feet above ground level, was undamaged and there is nothing to suggest that the aircraft had touched it. Although initially it was thought the accident may have resulted from an attempt to fly under the power line, this is not supported by the available evidence.

In terms of this particular crop spraying operation there was certainly no need for the pilot to attempt to fly under the power line; it would also have been out of keeping with his knowledge and experience of crop spraying in general and his previous work in this field. Although the aircraft's performance and handling capabilities make it theoretically possible for it to have been flown just under the power line and over the hedge such a flight path would have resulted in a steeply climbing attitude and a positively upward trajectory at the point of crossing the hedge. The evidence from the physical damage sustained by the tree is that the trajectory was level or even perhaps slightly downwards whilst the eyewitness evidence firmly refutes any suggestion of a steep climbing attitude at that point. It is therefore considered that the aircraft was flown over the power line.

If the pilot had chosen to do this whilst keeping minimum clearance then he would have required only a very slight climb to have crossed the highest tree. However the circum-

stances of the accident indicate that instead of doing this he made a relatively steep left bank to lift the right wing over the tree; such a manoeuvre would be appropriate either for entry into a dumbell turn preparatory to a return spraying run, or as a vigorous evasion of the high tree to be followed by a continuation of the spraying run into the next field. Whatever the reason for the banking manoeuvre in preference to the straight climb over the tree it is evident that the pilot was flying to very close limits. In such circumstances it would require only a very slight misjudgment for the left wing to brush the lower tree; this would appear to be the immediate cause of the accident.

Crop spraying operations are necessarily conditioned by the prevailing weather conditions, the stage of crop growth, customers requirements, etc with the consequence that pilots are faced with periods of comparative inactivity alternating with long duty periods and intensive flying; on the day of the accident the pilot's duty period was close to 12 hours. Although he had been able to obtain a little rest between individual flights, nevertheless, by the end of the duty period, he would almost certainly have been feeling some degree of fatigue and this may well have affected his concentration during the accident flight. It may also be relevant that this was his last work period of the day and it would have been a normal human reaction to wish to complete it as expeditiously as possible. Except in this context and that of tiredness at the end of a long day it is difficult to explain why a pilot of this considerable experience and proven ability should have allowed himself to get into a position where a small misjudgement would have such a major consequence.

The clothing worn by the pilot did not conform to the operator's instructions on the wearing of suitable protective clothing and a 'bone-dome' type of protective helmet, although it is true that in this accident such protection would not have decreased the injuries from which he subsequently died. Nevertheless it is evident that the wearing of such clothing would have reduced the severe burning, from which he also suffered. Although it is difficult for operators to enforce instructions of this nature it is obvious that the risk element in crop spraying operations is sufficiently high for pilots to take serious notice of such elementary precautions.

2.2 Conclusions

(a) Findings

- (i) The documentation of the aircraft was in order.
- (ii) There is no evidence of any pre-crash defect or malfunction of the aircraft, its engine or equipment.
- (iii) The pilot was properly licenced and adequately experienced to carry out the flight.
- (iv) The pilot had carried out a duty period of almost 12 hours when the accident occurred.
- (v) The pilot was properly briefed on the position of ground hazards before the flight but did not take with him the briefing sketch map.
- (vi) The pilot had previous experience in spraying the field from which the accident occurred and did not make an air reconnaissance of the field before spraying it.
- (vii) Whilst crossing the hedge at the eastern end of the field in a steeply banked altitude to the left the left wing of the aircraft passed through the upper part of a large tree about 30 feet above ground level, breaking off the spray boom equipment under that wing.

- (viii) About three seconds later the aircraft struck trees in a second hedge approximately 106 metres further on causing a severe pitch down manoeuvre from which the pilot had insufficient height to recover.

(b) *Probable cause*

The pilot misjudged the position of his left wing which struck a tree in the eastern hedge of the field he was spraying; he was unable to recover complete control before hitting further trees.

R D Westlake
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

April 1976