

ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

Brookland Hornet Gyrocopter G-AWTZ

Report on the accident at Woodford
Aerodrome, Cheshire on 27 June 1970

List of Civil Aircraft Accident Reports issued by AIB in 1972

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Department of Trade and Industry
Accidents Investigation Branch
Shell Mex House
Strand
London WC2

22 December 1971

The Rt. Honourable John Davies MBE MP
Secretary of State for Trade and Industry

Sir,

I have the honour to submit the report by Mr G M Kelly, an Inspector of Accidents, on the circumstances of the accident to Brookland Hornet Gyrocopter G-AWTZ which occurred at Woodford Aerodrome, Cheshire on 27 June 1970.

I have the honour to be
Sir,
Your obedient Servant,

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch

Civil Accident Report No EW/C351

<i>Aircraft:</i>	Brookland Hornet Gyrocopter G-AWTZ
<i>Engine:</i>	Brookland 1600 cc Volkswagen conversion
<i>Registered Owner and Operator:</i>	Brookland Rotorcraft Limited
<i>Pilot:</i>	Mr B R Luesley – killed
<i>Place of Accident:</i>	Woodford Aerodrome, Cheshire
<i>Date and Time:</i>	27 June 1970 at 1609 hrs
	All times in this report are GMT

Summary

The aircraft was making a demonstration flight during an air display. It made several low flights along the runway in front of the crowd, reversing direction at the end of each run by pulling up into a zoom and making a turn to the right and then to the left into a dive in the opposite direction. At the top of the last of these manoeuvres when the aircraft was banked vertically to the left the rotor appeared to slow down and the blades struck the fin and rudder. The aircraft crashed on the runway and the pilot was killed, there was no fire.

The report considers that the accident may have been the result of a temporary reduction of control forces in conditions of zero 'g' force at the top of the final turn and a loss of rotor speed following a loss of airflow through the rotor disc, but concludes that the evidence is insufficient to establish the cause.

1. Investigation .

1.1 History of the flight

As a participant in the Royal Air Force Association Air Display at Woodford Aerodrome the aircraft made a demonstration flight consisting of low level runs along Runway 08/24 in front of the crowd, with the aircraft flying about 50 feet above the ground. Direction was reversed at the end of each run by a power-on zoom to about 150 feet where the aircraft made a steep turn to the right and then to the left to dive back along the runway in the opposite direction. The manoeuvre took about 4 seconds to complete, and the aircraft was almost stationary, banked vertically to the left at the apex of each turn.

In the afternoon the fixed wing flying was delayed by bad weather and the pilot of the gyrocopter offered to fill in with a further demonstration. He took off at 1607 hrs and began the same flight pattern as before. However as the aircraft was flying downwind along Runway 08/24 it went into a zoom about 2,500 metres along the runway that was markedly steeper than the previous manoeuvres of the same sort. The aircraft banked steeply to the right and about 100 feet rolled into a steep left turn to reverse direction. At this point the rotor appeared to slow down and to oscillate. The rotor blades demolished the fin and rudder and then bent upwards and stopped. Meanwhile the sound of the engine ceased and the aircraft dropped its nose, rolled further to the left, and fell to the ground. It struck the runway on its port side and then became inverted. There was no fire but the pilot was killed.

1.2 Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal	1	-	-
Non-fatal	-	-	-
None	-	-	-

1.3 Damage to aircraft

Destroyed.

1.4 Other damage

Nil.

1.5 Crew information

Mr B R Luesley, aged 37 years, served in the Royal Air Force as a Master Engineer. In this capacity and as a crewman on Wessex helicopters, he served in Europe and the Middle East and accumulated 1,000 hours helicopter experience. During his service with the Royal Air Force he obtained a private pilot's licence and flew several types of light fixed wing aircraft. He learned to fly gyrogliders and powered gyroplanes at Membury during the period 1968-69. He left the Royal Air Force in 1969 and the same year joined Brookland Rotorcraft Limited. Later in the same year he was appointed Project Manager and test pilot of Gyroflight Limited, who became responsible for producing and marketing the 'Hornet' gyrocopter, and in this capacity demonstrated 'Hornet' G-AWTZ in the UK and abroad.

At the time of the accident his private pilot's licence was valid, endorsed for Groups A and B aeroplanes and single seat gyroplanes. He had completed 250 hours as pilot-in-command, of which approximately 60 hours were on gyrogliders and 60 hours on powered gyroplanes.

1.6 Aircraft information

Gyrocopter G-AWTZ was a single seater autogyro with a two-bladed gimbal-headed rotor. The aircraft was propelled by a pusher airscrew driven by a converted 1600 cc Volkswagen car engine. It was built in 1968 as a spindle headed machine by Brookland Rotorcraft Limited and registered in their name in June 1969. It first flew on 23 June 1969 as a 'Mosquito' but after modification, which included the change to a gimbal rotor head, it was re-named the 'Hornet'.

A certificate of airworthiness had not been issued for the aircraft but a 'permit to fly' was valid at the time of the accident that called for a permanent placard to be affixed to the aircraft in full view of the pilot and worded as follows: 'This aircraft has not been proved to comply with the airworthiness requirements. To minimise risk it should only be flown within the conditions and manoeuvres stated by the constructor to have been repeatedly experienced without trouble'.

The records indicate that the aircraft had completed 245 flights, amounting to some 42 hours flying.

1.7 Meteorological information

The weather conditions at the time were cloudy with 4/8 low cloud at 600 feet, 7/8 at 2,500 feet and intermittent rain. The wind was from 220° at 12 knots, visibility 2 to 3 miles. It is not considered that the weather had any bearing on the accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorder

Not applicable.

1.12 Wreckage

The wreckage caused an obstruction on the runway in use and it was removed to a hanger where it was examined the day after the accident. The examination showed that the main impact had been taken by the nose and port main wheel units. The rotor, mast, and the engine were still attached to the airframe and it was apparent that the fin and rudder units had been struck in flight by the rotor. Fragments of the fin and rudder were recovered in an area approximately 30 yards radius round the point of impact of the main wreckage. The rotor blades had severed the tips of the propeller.

A more detailed examination of the wreckage was carried out at the Royal Aircraft Establishment, Farnborough. The engine was removed and stripped but no evidence was found of any pre-crash mechanical failure or malfunction.

Detailed examination of the airframe revealed that both rotor blades had struck the fin and rudder three times and had then bent upwards; there were also signs of reverse bending on the blade attachment plates. All this damage is considered to have occurred before the aircraft struck the ground.

There was slight damage to the teeter stops which are designed to stop the rotor tilting too far, indicating they had been struck by the blade roots. Further damage occurred to the rotor blades and propeller, when they came into contact with one another when the aircraft struck the ground. Damage to the pitch beam in the head, the head-to-mast attachment bolts and the tubular pitch hinge within the pitch beam, showed that the tail of the aircraft and the rotor disc had moved towards one another. There were no indications of a similar movement in the forwards and sideways directions.

All damage to the control system was considered to have been the result of either impact with the ground or strikes from the rotor blades.

No failures or defects in any part of the aircraft were found which could have caused the rotor to strike the tail.

1.13 Fire

There was no fire.

1.14 Tests and research

A manoeuvre of a gyroplane involving a pull-up or zoom followed by a control column movement forward or 'push-over' was analysed mathematically. From this it appeared that there was nothing to suggest any potential danger in the manoeuvre. In the analysis rotor blade flapping angles were calculated and found to be quite small. However there is a control feature that assumes importance in any manoeuvre in this type of gyroplane that involves a 'push-over', or a reduction of normal 'g' forces. A rotorcraft with a rigid see-saw rotor blade depends entirely on the tilt of the rotor thrust vector for its control moments. The control moment is therefore proportional to the applied 'g' and becomes correspondingly low in 'push-over' manoeuvres. If negative 'g' were to be applied the control would be reversed. In conditions of no thrust, no control moment is available.

2. Analysis and Conclusions

2.1 Analysis

An approximate profile of the last manoeuvre was built up from a video tape of part of the previous demonstration which had included the 180° turn, plus a film showing the aircraft's entry into the final fatal manoeuvre, and the evidence of several eye witnesses.

This profile showed that the flight across the airfield from west to east before the turn was between 50 and 100 feet. The aircraft, just before commencing the turn manoeuvre, descended to a few feet above the runway, probably to increase speed, and then turned to the right, climbing smoothly but steeply. It then began a turn to the left to fly back down the runway, but as it turned, the nose went down and it appeared to one witness as though the aircraft was doing a 'wing-over' that had been overdone. At this juncture the aircraft was about 100 feet above the runway in a nose down attitude, presenting a plan view to the spectators who were looking into the cockpit with the nose of the aircraft pointing north.

The rotor appeared to lose momentum and to turn very slowly while the machine fell, still in the same attitude, and struck the runway.

In the absence of any evidence of failure or malfunction of the aircraft or its control systems, or of incapacity of the pilot, and in the light of what little is known about the characteristics of this type of aircraft, the reason for the accident has not been established. But the profile that was built up suggests the hypothesis that the 'wing-over' manoeuvre resulted in a reduction of 'g' – possibly to zero – at the apex of the manoeuvre. If the 'g' had become very low, or non-existent, Mr Luesley would for the time being have run out of control, as described in 1.14, and could have had little influence on the subsequent few moments of flight. Low 'g' and low airspeed – two features of the apex of the 'wing-over' manoeuvre – could have led simultaneously to a diminution of rotor speed and a temporary loss of control. Such a combination would result in the rotor flapping uncontrollably when the airspeed increased again as the manoeuvre progressed.

This is the third of four such accidents to gyrocopters since September 1969, all of which exhibit the same phenomenon of the rotor coming into contact with the fin. In no case has evidence so far come to light to establish a cause, common or otherwise.

2.2 Conclusions

(a) *Findings*

- (i) The pilot was properly licensed.
- (ii) The aircraft had a current 'permit to fly'.
- (iii) There was no evidence of pre-crash failure or malfunction of the aircraft that would explain the rotor striking the fin or incapacity of the pilot.
- (iv) It is possible that the reduction in 'g' force and the loss of airspeed at the apex of a 'wing-over' manoeuvre brought about a loss of control and rotor flapping that the pilot was unable to prevent.

(b) *Cause*

There was insufficient evidence to establish the cause of the accident, but it is probable that a decay in airspeed and a reduction of normal 'g' forces at the apex of a 'wing-over' type of manoeuvre led to a loss of control of the rotor.

G M Kelly
Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry
December 1971