

ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

Chipmunk DH C 1 Series 22
G-AOTH
Report on the accident at Fawley,
Buckinghamshire on 6 February 1970

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

25 May 1971

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

Sir

I have the honour to submit the report by Mr R C Warren, an Inspector of Accidents, on the circumstances of the accident to Chipmunk DH C 1 Series 22 G-AOTH which occurred at Fawley, Buckinghamshire on 6 February 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/C/337/01

Aircraft: Chipmunk DH C 1 Series 22 G-AOTH
Engine: D H Gipsy Major 10 Mk 2
Registered Owner: West London Aero Services Ltd.
Operator: West London Aero Club
Crew: Instructor – Mr R E Hollis – Seriously injured
Pupil – Mr G V L Mucca – Killed
Place of Accident: Fawley, Buckinghamshire
Date and Time: 6 February 1970 at approximately 1625 hrs.
All times in this report are GMT

Summary

The aircraft was carrying out a dual training flight from White Waltham aerodrome and the instructor having completed an aerobatic sequence, attempted to demonstrate a spin to the left from 6,200 ft. At the moment of entry, the aircraft, having started to roll to port, yawed abruptly to starboard and entered a right hand spin from which all attempts at recovery failed. The pupil in the front seat was killed and the instructor received serious injuries. No evidence of pre-crash malfunction was found and the reason why the instructor was unable to effect recovery from the spin has not been determined.

1. Investigation

1.1 History of the flight

The aircraft took off at 1550 hrs from White Waltham airfield on a training flight with an instructor and a pupil pilot. The detail was planned to include instruction in steep turns, stalls and spins and a demonstration of aerobatics by the instructor at the request of the pupil. When the aerobatics, which included several rolls and stall turns, had been completed the aircraft climbed to 6,200 ft amsl and carried out a number of stalls including one in which an abrupt starboard wing drop occurred.

After height had been regained, pre-spin precautionary checks were completed prior to initiating a spin to the left. As the speed dropped to about 55 knots left rudder was applied. The aircraft started to roll to port until, without warning, it yawed abruptly to starboard with the nose describing an arc above the horizon and entered a right hand spin. Right rudder was applied and the spin allowed to develop through approximately 5 turns while the behaviour of the flight instruments was demonstrated.

According to the instructor's account of the sequence of events that followed, he initiated recovery action and when the left rudder was applied the rate of rotation decreased slightly. After a pause the control column was pushed forward and the rotation rate increased and was accompanied by a flattening of the aircraft's pitch attitude. The aircraft settled into a condition which he described as a fast, flat spin with high centrifugal forces and in which the controls felt very slack. The normal recovery technique was again tried but as this also proved unsuccessful in arresting the spin, emergency measures were carried out. Application of engine power simultaneously with down elevator in order to produce a rocking motion appeared only to flatten the pitch attitude, while changing the elevator trim position between fully aft and fully forward and raising and lowering the flaps proved equally ineffective in altering the characteristics of the spin. Since neither pilot was wearing a parachute these measures were continued until the aircraft struck the ground.

When eye witnesses arrived shortly after the crash they found the pupil in the front seat unconscious with severe head injuries. He was not moved and died before medical assistance could arrive. The instructor in the rear seat was partly conscious and was helped from the cockpit and taken to hospital.

1.2 Injuries to persons

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

1.3 Damage to aircraft

Destroyed.

1.4 Other damage

None.

1.5 Crew information

Mr R E Hollis, aged 45, learned to fly in the Royal Air Force. After demobilisation in 1946 he served in the Royal Air Force Volunteer Reserve and flew Tiger Moth and Chipmunk aircraft until the Reserve was disbanded. Later, for a period of about 3 years he owned and flew a Chipmunk. In the second half of 1969 he completed a flying instructor's course with the West London Aero Club at White Waltham during which the special characteristics of the Chipmunk spin were thoroughly demonstrated. During the subsequent flying test which preceded the issue of an instructor's rating, and which was conducted in G-AOTH with Mr Hollis in the rear seat, it was noted by the examiner that recovery from the test spins took longer than normal and a discussion was held about how various factors such as an aft centre of gravity position might affect the recovery behaviour. At the time of the accident Mr Hollis had accumulated just over 900 hours' flying experience which included about 250 hours on the Chipmunk. He held a valid private pilot's licence with an IMC rating plus an assistant instructor's rating excluding night flying and aerobatics except spinning.

Mr G V L Mucca, a Frenchman, aged 27 years, joined the West London Aero Club to acquire ground training and flying experience necessary for the issue of a private pilot's licence. He had passed the medical examination required for the issue of a student pilot's licence. He had completed 6½ hours dual instruction with Mr Hollis.

1.6 Aircraft information

G-AOTH was built by the de Havilland Aircraft Company in 1950 and after service with the Royal Air Force was modified to civil airworthiness requirements and placed on the civil register on 3 July 1956. It was fitted with a short chord rudder and anti-spin strakes. The aircraft was acquired by West London Aero Services Ltd on 23 January 1968. It had a valid certificate of airworthiness in the transport category (passenger) and a current certificate of maintenance. The aircraft had flown 2,762 hours.

In 1962 the aircraft was extensively damaged during a forced landing and it was again damaged in June 1966; both accidents required extensive repairs. Spin recovery during the test flight that followed the second accident was accomplished in 1½ turns but the aircraft showed a tendency for the right wing to drop when stalled. In June 1969, when the aircraft was test flown

for the renewal of the certificate of airworthiness, recovery from the right hand spin took 3 turns and the aircraft lost approximately 1,700 feet in height.

The aircraft was last weighed on 30 June 1969 and its empty weight and centre of gravity position established. The respective weight of each pilot on the subject flight was 123 lb in the front seat and 220 lb in the rear seat; it was estimated that there was a maximum of 12 imperial gallons of fuel remaining at the time of the accident. Using these figures, the centre of gravity position was calculated to be 1.6 inches forward of the datum. The limits of the centre of gravity position given in the flight manual are between 6.8 inches and .77 inches forward of the datum and, therefore the position on this flight, although towards the rear end of the range, was within the prescribed limits.

1.7 Meteorological information

The weather over the south of England was generally dry with good visibility and there were only very small amounts of cloud. Winds were light and there was very little turbulence at the lower levels.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Not applicable.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorders

Not required, none fitted.

1.12 Wreckage

The aircraft crashed on level ground about 500 ft amsl. Examination showed that it had hit the ground at low forward speed, in a slightly nose-down attitude and that it was turning to the right on impact. With the exception that the engine had been almost severed from the fuselage, the aircraft had remained substantially intact although it had been badly distorted. Damage to the propeller indicated that it had been rotating under a small degree of power. The port tank contained 4 gallons of fuel and the starboard 3 gallons but some fuel had been spilled overboard due to the tanks being crushed. The flaps were found retracted and operated satisfactorily on test. Although both hand brake levers were found partially on, they were unlatched and tests have shown that they were most probably in the "OFF" position prior to impact.

No evidence was found of malfunction or restriction in the flying control system other than that attributable to ground impact. The incidence of the tailplane was the only part of the aircraft's rigging that could be checked and for this the fin spar had to be used as the datum instead of the normal

fuselage datum. The port tailplane incidence was found to be $-0^{\circ} 30'$ and that of the starboard tailplane $-0^{\circ} 40'$. The drawing requirements are $-1^{\circ} \pm 15'$; it is possible that the small deviation from these requirements resulted from using the tin as an alternative datum. The range of movement of the elevators was from 11.75 inches up to 4.75 inches down which is within the specified requirements.

1.13 Fire

There was no fire.

1.14 Survival aspects

The first eye witnesses arrived at the aircraft almost immediately and were followed by the police and ambulance services within about 15 minutes. The pupil was alive when first found but died before medical assistance arrived. Death was attributed to injuries received when his head hit the instrument panel after he had jack-knifed beneath the cockpit coaming. The early rescuers have stated that his safety harness was found to be fairly loose but this may have resulted from the additional cushions on which Mr Mucca sat having moved during the impact. Since the accident was survivable it is possible that the effectiveness of the full safety harness was impaired by the use of these additional seat cushions, thereby allowing a greater forward body movement.

2. Analysis and Conclusions

2.1 Analysis

2.1.1 *Background to Chipmunk spinning characteristics*

There have been a number of spinning accidents to Chipmunks in the past. The majority of these occurred in the years following the aircrafts' introduction into service with the Royal Air Force and, to a lesser degree, after its introduction into civil aviation. There have also been reports of pilots experiencing difficulty when trying to recover from a spin. Although the number of these incidents has been small, their nature has been significant enough to cause the airworthiness authorities in the United Kingdom and Australia to initiate further flight tests on the aircraft. The reports of the Australian tests in particular noted that the Chipmunk displayed its own individual characteristics when being spun which included an occasional tendency to perform as many as 3½ turns from the time recovery was initiated until it was completed. It was concluded however, that no evidence had been found that a Chipmunk would not recover from a spin provided that the correct spin recovery technique was applied and maintained until rotation had ceased. It was stressed that pilots should be aware that the aircraft displayed characteristics which could result in delayed recovery from a true spin and should not confuse the true spin with the semi-stalled spiral stage through which the Chipmunk first passes and from which recovery is easily effected. There is no doubt that in the past pilots who have not previously experienced a well developed spin have failed to regain control of the aircraft through not applying and sustaining for long enough the correct spin recovery technique.

Various factors associated with this accident such as the instructor's spinning experience and recovery technique, the condition of the aircraft's structure, and any peculiarities in the nature of the spin have been examined with reference to the reports of these tests to see whether any reason could be found why the subject aircraft failed to recover from the spin.

2.1.2 *The aircraft*

Examination of the wreckage revealed no evidence of any malfunction which might have affected the spin recovery. Although the tailplane incidence was found to be slightly outside the drawing requirements the difference was not considered to have been significant and indeed may have been the result of using the fin spar as an alternative datum for measurement. There was no evidence of any jamming of the control surfaces or runs and it was considered that the handbrake was off prior to impact and therefore did not restrict the rudder pedal movement. Normal elevator travel was available to the pilot but it was not possible to ascertain whether full deflection of the rudder and ailerons was available nor to check the aircraft's complete rigging.

2.1.3 *Instructor's experience*

The behaviour of the Chipmunk when spinning had been fully demonstrated to Mr Hollis during his course with the West London Flying Club. At the end of 1969 he had passed the flying test which precedes the issue of an assistant instructor's rating and during which recovery from demonstration spins had been prolonged. From this it is clear that he had recent knowledge of the prolonged type of recovery that has misled less experienced pilots in the past.

The possibility that Mr Hollis suffered disorientation was also considered since the aircraft behaved unexpectedly when it entered a spin in the opposite direction to that intended. He has stated, however, that as this was a training flight, he continued to talk to the pupil throughout the spin explaining to him how to interpret the information shown on the flight instruments and that he was, therefore, fully aware of the aircraft's unusual behaviour.

It appears unlikely, therefore, that the failure to arrest the spin was caused by either lack of experience or disorientation.

2.1.4 *The spin*

There are several factors about this particular spin which need to be considered. The first relates to the unplanned manner of entry. The aircraft had exhibited a tendency for the right wing to drop when it was being intentionally stalled and this had happened quite markedly during one stall earlier in the flight. Any tendency for one wing to stall before the other is accentuated when it is accompanied by a rapid rearward movement of the control column such as might occur during entry to a spin. It is possible, therefore, that the aircraft's initial roll to the left when port rudder was applied was interrupted by an abrupt stall of the starboard wing which caused the aircraft to transfer into a spin in the opposite direction to that intended. The Australian tests showed that the manner of spin entry could affect the mode of the ensuing spin; there is insufficient information, however, to be able to say what effect this particular entry might have had.

Another factor which may have been significant concerns the gyroscopic effect due to the rotation of parts of the engine and propeller. If the direction of rotation of the propeller is opposite to the direction of rotation of the aircraft then the nose of the aircraft will tend to rise and the tendency to spin will be increased. The direction of rotation of the Chipmunk's propeller is anti-clockwise when viewed from the cockpit which is opposite to the direction of rotation of the aircraft in this particular spin.

Finally, the instructor's description of the events during the initial recovery attempt has to be taken into account. He stated that the rate of rotation decreased slightly when left rudder was applied and increased again as the control column was pushed forward. This conforms to the normal recovery pattern for this type of aircraft but it is usually accompanied by a nose-down steepening of the attitude prior to the cessation of rotation. The instructor stated, however, that the attitude became flatter in relation to the horizon as the rotation rate increased. He described this phase of the spin as being flat, fairly fast, with high centrifugal forces and with the control responses appearing very slack.

The question is raised, therefore, whether the combined effect of factors such as the unusual entry, the gyroscopic effect of the propeller's rotation, the rearward position of the centre of gravity and the particular weight distribution on this occasion could have upset the balance of the forces acting on the aircraft and produced an unusually flat attitude. In such a condition the effectiveness of the elevator and rudder control surfaces might have been reduced thus adversely affecting the recovery characteristics.

2.1.5 *Observations*

The evidence from the extensive flight testing of the Chipmunk showing that the aircraft will always respond to the correct spin recovery technique conflicts with the instructor's account of his unsuccessful attempts to arrest the spin. No evidence was found of any malfunction in the aircraft which might have affected its handling qualities. Unfortunately, no further information concerning the spin came to light during the investigation other than that given by the instructor in his statement.

Experience has shown that detailed recollections of such manoeuvres, particularly when they terminate in a violent manner, do not necessarily accurately reflect the actual events, specially where the manner and rate of control application is concerned, and, therefore, need to be treated with reserve. This does not mean that the integrity of the instructor's statement is challenged nor does it deny that his observations may indeed be accurate. It follows, however, that any argument based solely on this type of information can be submitted only for comment and cannot be accepted as conclusive unless other confirmatory evidence is available. For this reason it has not been possible either to resolve the conflict between the behaviour of the Chipmunk aircraft during the various flight trials and the apparent behaviour of the subject aircraft during this particular spin manoeuvre, or to determine the cause of the instructor being unable to effect recovery from the accident spin.

It is open to discussion whether the effectiveness of the control surfaces might have increased as the aircraft descended and that there might have been a successful recovery if the initial anti-spin control had been sustained beyond the period that normally ensures recovery. The aircraft was losing height rapidly, however, and the instructor's decision is understandable in deciding to apply emergency actions after it had appeared to him that normal recovery action had failed and that the control surfaces had become ineffective.

2.2 **Conclusions**

(a) Findings

- (i) The aircraft had been properly maintained, and its documentation was in order.
- (ii) The centre of gravity was within the prescribed limits.
- (iii) The instructor was properly licensed.
- (iv) There was no evidence of pre-crash failure or malfunction of the aircraft.
- (v) The aircraft was intentionally put into a spin for instructional purposes but recovery was not made before it struck the ground.

(b) *Cause*

The instructor was unable to effect recovery from an intentional spin for reasons which have not been determined.

R C WARREN
Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry
25 May 1971