
ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

Owl Racer 65-2 G-AYMS
Report on the accident at
Greenwich Reach, River Thames,
London, on 31 May 1971

List of Civil Aircraft Accident Reports issued by AIB in 1974

| <i>No</i> | <i>Short title</i> | <i>Date of publication</i> |
|-----------|---|----------------------------|
| 1/74 | McDonnell-Douglas DC8 – 63 CF N 801 WA and Aerospatial Caravelle 6 N 00–SRG approximately 10 nautical miles southest of Lands End VOR, March 1973 | April 1974 |
| 2/74 | Piper PA 30 Twin Comanche G–AXRW at Shipdham Aerodrome, Norfolk, January 1973 | April 1974 |
| 3/74 | Slingsby T61A G–AYUO near Wycombe Air Park, Bucks., February 1973 | May 1974 |
| 4/74 | Viscount 802 G–AOHI at Ben More, Perthshire, Scotland, January 1973 | May 1974 |

Department of Trade and Industry
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R 0DP

18 December 1973

The Rt Honourable Peter Walker MBE MP
Secretary of State for Trade and Industry

Sir,

I have the honour to submit the report by Mr W H Tench, an Inspector of Accidents, on the circumstances of the accident to Owl Racer 65-2 G—AYMS which occurred at Greenwich Reach, River Thames, London on 31 May 1971.

I have the honour to be
Sir
Your obedient Servant

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch
Civil Aircraft Accident Report No 5/74
(EW/C381)

Aircraft: Owl Racer 65-2 G-AYMS
Engine: 95 hp Continental 090-12F
Registered Owner: Farm Aviation Ltd, Rush Green, Hitchin,
Hertfordshire
Pilot: Mr P T Gent Eggett - Killed
Passengers: Nil
Place of Accident: Greenwich Reach, River Thames, London
Date and Time: 31 May 1971 at 1800 hrs

All times in this report are GMT

Summary

A section of one blade of the propeller broke off when the aircraft was crossing the River Thames at approximately 1,500 feet. The severe out of balance forces which resulted tore the engine from the fuselage and this in turn made the aircraft difficult for the pilot to control. He attempted to make a forced landing in the river but the aircraft struck the water with considerable force and the pilot received fatal injuries.

The fracture of the propeller blade was associated in varying degrees with overload, fatigue and corrosion.

1. Investigation

1.1 History of the flight

The aircraft was on a flight to Redhill Aerodrome after having completed a racing programme at North Weald. It carried sufficient fuel for two hours flying when it took off with an estimated all-up weight of 910 lbs. The pilot of the Owl aircraft appears to have followed the direct track to Redhill since his aircraft was seen approximately ten minutes after take-off approaching the River Thames near Greenwich flying in a southerly direction.

As the aircraft was crossing the river there was a loud report. It continued to fly erratically for a short distance on a southerly heading before making a descending turn to the left through 270°, culminating in a shallow dive into the water. Parts of the aircraft, including the engine and propeller, were seen to fall away but the major portion plunged into the river. The engine and the remains of the propeller still attached to it, which were subsequently recovered, fell through the roof of a factory on the south bank.

The half submerged aircraft remained afloat and a rope was attached to it from a pleasure boat which arrived quickly on the scene. The pilot appeared to be unconscious. After unsuccessful attempts had been made to open the cockpit canopy and release him, the aircraft was towed to the bank where the canopy was forced open. The pilot was subsequently found to be dead.

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

The aircraft was destroyed.

1.4 Other damage

A factory on the south side of the Thames was damaged when the engine and propeller which had broken away from the aircraft fell through the roof.

1.5 Crew information

Mr P T Gent Eggett, aged 32, held a valid Private Pilot's Licence for Group A

aircraft. Excluding the accident flight, he had flown a total of 274 hours 45 minutes. He made a 20 minute flight in the Owl Racer at Redhill on 29 May and a 25 minute flight ferrying the aircraft from Redhill to North Weald on the following day. Mr Gent Eggett, who weighed 196 lbs, was employed by the Air Registration Board (ARB) as a flight test observer, but he flew the aircraft in a private capacity and not in the course of his official duties.

1.6 Aircraft information

1.6.1 Certification

Owl Racer 65-2, G-AYMS, was a single seat racing monoplane of mixed wood and metal construction. It was assembled by Farm Aviation Ltd under the supervision of their Mr W S Bowker. In order to facilitate the certification procedure for ultra-light aircraft, the Department of Trade and Industry (DTI) had agreed that the Popular Flying Association (PFA) should make recommendations to the ARB regarding the issue of Permits to Fly and in the case of the subject aircraft Mr F I V Walker acted in this capacity for the PFA.

In May 1970 Mr Bowker sent Mr Walker the specification drawing which showed that a 60 inch maximum diameter propeller was required and on 16 March 1971 Mr Bowker informed Mr Walker in writing of his intention to test the aircraft with a completely standard propeller. Subsequently Mr Bowker indicated that a modified propeller with a reduced diameter and coarser pitch would be fitted for racing. Mr Walker asked for the serial numbers of the propellers for the Permit and stated that when the final propeller was fitted the data could be altered. Mr Bowker passed the type and serial numbers of both propellers on 26 March 1971.

Mr Walker sent a letter to the ARB on 29 March 1971 recommending that a Permit to Fly for test purposes should be issued in respect of G-AYMS. On 8 April 1971 the DTI issued a Test Permit to Fly which included the following limitations:

- (a) the aircraft shall not operate at a weight in excess of 840 lbs;
- (b) the maximum engine rev/min shall not exceed 2,625 rev/min and the maximum continuous rev/min shall not exceed 2,475 rev/min;
- (c) the aircraft shall be flown only for test purposes by a pilot nominated by the PFA;
- (d) the aircraft shall not be flown over any assembly of persons or over any congested area of a city, town or settlement;
- (e) no unauthorised alteration or replacement shall be made to the aircraft, its engine or propeller.

The aircraft first flew on 13 April 1971 and after a second flight on the following day a modified propeller of smaller diameter and coarser pitch was fitted. The aircraft was then subject to a comprehensive flight test programme during which it was noted that on the ground the full throttle rev/min were 2,800 and up to 3,500 rev/min were achieved in the air.

The pilots nominated by the PFA in accordance with (c) above were Mr W S Bowker, Mr M A Kelly and Mr K O Cunningham Brown.

The issue of a Test Permit to Fly was intended to allow the constructor to fly the aircraft and establish the basic flight characteristics and to correct any faults arising during the flight test programme prior to submitting the aircraft to the PFA for its final design inspection and test flight. On successful completion of this stage the PFA would advise the ARB that a normal Permit to Fly could be recommended. At the time of the accident the stage had been reached where the final inspection and test flight had been arranged to take place on 1 June 1971.

An application to the PFA for permission to race the aircraft on 31 May was refused on the grounds that more information was required regarding engine data and the 'g' limitation of the wing and that modifications were necessary to the cockpit canopy release. However, during the evening of 27 May Mr D Stinton, an ARB test pilot, flew the aircraft and expressed general satisfaction with it following which the ARB staff expressed the view in telephone discussion with the PFA that subject to the cockpit catches being modified the aircraft could be permitted to race. On the evidence available and prior to the final inspection being undertaken by the PFA, the ARB recommended to DTI that the aircraft should be permitted to race. Consequently, the DTI sent the following telegram to Mr Bowker on 28 May 1971: 'Owl Racer OR65-2 Golf Alpha Yankee Mike Sierra is hereby permitted to take part in races at North Weald on Monday, 1 June 1971 providing the canopy is modified as agreed between ARB/PFA earlier. This signal to be attached to the Permit to Fly.'

1.6.2 *The unmodified propeller*

The aircraft was fitted initially with a McCauley 1B90/CM propeller, serial number 31206, with a diameter of 73 inches and a pitch of 43 inches. The issue of the Permit to Fly for test purposes related to the aircraft fitted with this propeller. According to the aircraft log book the unmodified propeller was removed after the first flight made on 14 April 1971.

1.6.3 *The modified propeller*

The modified propeller was originally a standard McCauley 1B90/CM of 73 inches diameter and a pitch of 45 inches with serial number 34191. It was fitted to a new Aeronca Champion G-ARAR from January 1961 until September 1962 when both blades were damaged at the tips during a taxiing accident. No documentation has been traced concerning the propeller between September 1962 and June 1965 when it was again fitted to G-ARAR, though with a diameter this time of 70.5 inches.

In March 1970, when the propeller had a recorded total flying time of 626 hours, it was again damaged at the tips and one blade was bent back approximately 20°. Farm Aviation Ltd then sent it to a Mr D M Squires, a senior employee of a propeller manufacturing company, who undertook to have the repair and modification attempted by his company. Farm Aviation Ltd were later informed that there would be no charge for the work but that the company could extend no warranty nor accept any responsibility for the propeller.

The bent blade was straightened and the propeller diameter reduced to 58.25 inches. It was intended to change the pitch to 62 inches but the blade angles achieved were appropriate to a pitch somewhat less than this figure. After this work was done, the propeller was statically balanced and lightly scuffed and polished on the face side only of the blades. Both before and during the modifications dye penetrant

crack detection tests were made and finally, before painting, a close visual inspection was carried out. At no time were any signs of cracks found. There is no record available of these repairs or modifications. No steady or vibratory strain gauge stress survey was conducted on the propeller after it had been shortened to a diameter of 58.25 inches. (See Appendix 1)

It is estimated that at the time of the accident the propeller had flown a total of 642 hours.

1.7 Meteorological information

The weather was good and is not considered to be a significant factor in the accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The aircraft was not fitted with radio equipment.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorder

No flight recorder was fitted or required.

1.12 Wreckage

The wreckage remained afloat in a nose-down attitude after the aircraft struck the water. There was little impact damage to the airframe but during the attempts to extricate the pilot and salvage the aircraft more damage was sustained. The perspex canopy and its frame were damaged but the canopy fasteners and hinges remained intact. The forward auxiliary canopy fastener was secured, apparently from the inside, and it was noted that no external means of release was incorporated. The four welded joints of the tubular engine mounting structure had failed at the bulkhead stations in a forward and downward direction. Examination of the airframe showed no indication of pre-crash defect or malfunction of the flying controls.

The engine and approximately three-quarters of the propeller were recovered in a badly damaged condition from a building on the south bank of the river about a quarter of a mile from the position where the aircraft crashed. One blade of the propeller was found to have fractured approximately 12.75 inches from the centre of the hub in a manner consistent with failure in flight. The remaining quarter of the propeller which probably fell into the river was not recovered. Strip examination of the engine disclosed no indication of mechanical failure and showed evidence of normal running.

1.13 Medical and pathological information

The pilot was not drowned; his death was attributed to a massive fracture of the base of the skull combined with an extension fracture of the neck. A deep abrasion was present on the point of the chin and there was a circular abrasion high up on the central forehead.

The combination of chin injury and the type of fracture at the base of the skull is typical of severe impact to the point of the chin. Considered in combination with the abrasion of the upper forehead and the fracture of the neck there seems to be conclusive evidence that the pilot swung forward, striking his chin on the main spar and his forehead on the instrument panel.

The crash impact forces were such that survival could have been expected of a pilot restrained by a safety harness in a conventional cockpit. In this case survivability was compromised by the shortcomings of the design of the shoulder harness combined with the position of the main spar which passed through the cockpit immediately below and aft of the instrument panel.

1.14 Fire

There was no fire.

1.15 Survival aspects

The aircraft was fitted with a full shoulder type harness for the pilot. The two shoulder straps were attached to a common shackle plate which in turn was attached to a tubular fuselage cross member by means of a pinch bracket round the horizontal cross member with the bolt at the top. The low position of the harness strap attachment in relation to the level of the pilot's shoulders did not afford maximum restraint to the pilot. (See photograph at Appendix 2.) Inertia loads on impact bowed the tubular cross member forward for 1.5 inches and caused the pinch bracket to rotate some 70° forward, the result of which was further to reduce the effectiveness of the pilot's shoulder harness. No protective helmet was worn by the pilot.

1.16 Tests and research

Examination of the propeller by the Materials Department, Royal Aircraft Establishment (RAE) indicated that the alloy from which it was made met the required specification and that the failure of the blade had occurred primarily due to fatigue propagation from at least two origins located on the camber face of the blade, at a distance of approximately 12.75 inches from the centre of the hub. Metallographic examination showed these origins were coincident with areas of intergranular corrosion. Fatigue crack propagation had extended through approximately 75 per cent of the thickness of the section before final overload failure occurred.

Many small blisters were observed in the silver-grey painted camber surface. When the paint was chemically stripped these were found to be associated with numerous areas of surface corrosion pitting. The camber surface of the blade had an anodised appearance while the convex or face side of the blade showed evidence of abrasive cleaning.

No evidence of anodising penetration was found associated with the areas of corrosion.

2. Analysis and Conclusions

2.1 Analysis

2.1.1 *The final manoeuvres*

The absence of any observed flare before ditching together with the substantial change of centre of gravity of the aircraft when the engine became detached indicate that the aircraft was not fully controllable during the final manoeuvre. The cause of the accident must be regarded therefore as being directly related to the detachment of the engine. The reason why it became detached was that the severely unbalanced forces on the engine resulting from the separation of part of one blade of the rotating propeller exceeded the strength of the engine mounting structure.

2.1.2 *The fractured propeller*

The fracture of the propeller blade was caused by a fatigue crack that progressed to failure by sudden rupture due to overload of the reduced cross-sectional area. There is no evidence that the cold bending process employed to straighten the propeller, nor indeed the earlier accidental bending damage to the propeller, was associated with its ultimate fracture.

There were several shallow areas of corrosion pitting on the camber face which had been painted silver-grey after the blades were cropped. The ultimate fracture, which was due to fatigue, originated at some of these sites of corrosion. Although the degree of corrosion was of a low order the corroded areas had the effect of providing focal points from which fatigue cracks could propagate.

The absence of any steady or vibratory strain gauge stress survey subsequent to the ultimate cropping of the modified propeller resulted in the level of vibratory stress contribution to the fatigue failure remaining unestablished. Without such tests the safety of the modified propeller/engine combination for use up to 3,500 engine rev/min was unknown.

It is improbable that either Mr Bowker, who was responsible for the construction of the aircraft, or Mr Squires, who arranged for the modifications to be carried out on the propeller, were aware of the potential consequences of the cropping of the propeller, originally of 73 inches diameter, to the much reduced figure of 58.25 inches.

Although Mr Walker of the PFA was aware of the intention to fit a modified propeller no intimation was given to him that it had in fact been fitted to the aircraft and no detailed information about its history was made known to him. Permission to race the aircraft was granted by the DTI following a recommendation to do so from the ARB after the PFA had been persuaded to acquiesce.

2.1.3 *The Test Permit to Fly*

The detailed examination of the airworthiness of the aircraft which had been

entrusted to the PFA by the ARB was, so far as it had proceeded, carried out with competence and an attitude of responsibility. This arrangement for examining new ultra-light aircraft design and construction relieved the ARB of the time-consuming work-load involved whilst at the same time ensuring that there was an appropriate degree of supervision of the airworthiness of home-built and racing aircraft at an economical cost to the applicant. To be fully effective this arrangement requires the uninhibited support and co-operation of the aircraft constructor.

At the time of take-off on the accident flight it is estimated that the weight of the aircraft was 70 lbs greater than the maximum total weight authorised of 840 lbs allowed by the Test Permit to Fly although this is not considered to have been a factor in the accident.

All the indications are that the maximum engine speed limitation of 2,625 rev/min contained in the Test Permit to Fly was most probably exceeded on the ground and in the air on every occasion that the aircraft flew. Both test pilots who flew the aircraft reported in writing that the maximum engine speed limitation contained in the Test Permit to Fly was readily exceeded, but no action was taken either to modify the permit to allow a higher rev/min or to ensure that the limits already set were not exceeded.

Mr Gent Eggett was not one of the pilots nominated by PFA to fly the aircraft. However, the condition of the Test Permit to Fly which restricted flying the aircraft only for test purposes by pilots nominated by the PFA was amended by the telegram of 28 May from the DTI to the extent that it permitted the aircraft to be used for racing. This amendment was insufficiently clear in that it did not indicate whether the restriction to nominated pilots was to continue or not.

The position of the accident indicates that the aircraft was flown over the congested area in the vicinity of Greenwich in disregard of the condition laid down in the Test Permit to Fly prohibiting flight over any congested area of a city, town or settlement. It was indeed fortunate that the pilot retained sufficient control of the aircraft after the engine had separated from its mountings to be able to place it in the river rather than hazard the people on the ground in the near vicinity.

The Test Permit to Fly was issued in respect of the aircraft when it was fitted with the unmodified propeller and the fitment of the modified propeller was contrary to the condition which specifically prohibited, inter alia, the replacement of the propeller. There can be little question that the fitment of the modified propeller was directly related to the cause of the accident and the fact that its fitment was not made known to the PFA at the appropriate time was in disregard of the established procedure devised to ensure the airworthiness of this category of aircraft.

This accident illustrates the fact that the conditions contained in the Test Permit to Fly are drawn up to safeguard the people who fly in the aircraft from any shortcomings of design and construction and to prevent unnecessary hazard to the public upon whom it might fall. The attitude of those who operated and flew the aircraft towards the conditions contained in the Test Permit to Fly was too casual and they allowed their enthusiasm for this promising aircraft to influence their judgement away from the course of prudence.

2.2 Conclusions

(a) Findings

- (i) The documentation of the aircraft did not relate to the propeller which was fitted to the aircraft at the time of the accident, otherwise it was in order.
- (ii) The pilot was properly licensed.
- (iii) The conditions contained in the Test Permit to Fly were not observed in the following respects:
 - (a) the weight of the aircraft was 70 lbs greater than the permitted maximum (this was not a factor in the accident);
 - (b) the aircraft was flying over a congested area of a town when the accident occurred;
 - (c) the replacement of the unmodified propeller by the modified propeller was not authorised by the proper authorities;
 - (d) the maximum permitted engine speed of 2,625 rev/min was probably exceeded on every flight.
- (iv) The propeller fractured in flight after having been considerably reduced in diameter since manufacture.
- (v) The aircraft was no longer completely controllable by the pilot after the engine became detached following the failure of the propeller blade.
- (vi) The accident was survivable but the short-comings of the shoulder harness attachments permitted the pilot to strike his head and sustain fatal injuries.

(b) Cause

The accident was caused by the failure of a propeller blade in flight which gave rise to severely unbalanced forces on the engine and its subsequent detachment. This deprived the pilot of the ability to maintain full control of the aircraft.

W H Tench
Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry

December 1973