Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-021
Final

Collision with terrain
7 km north-east of Camden, NSW
18 March 2008

VH-NUK, Pitts S-2A

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Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Published by: Australian Transport Safety Bureau
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Internet: www.atsb.gov.au

ISBN and formal report title: see 'Document retrieval information' on page iii.

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
AO-2008-021	10 February 2009	17	978-1-921602-09-2

Publication title

Collision with terrain VH-NUK, Pitts S-2A, 7 km NE Camden, NSW, 18 March 2008

Prepared by

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Reference No.

INFRA-08390

Acknowledgements

Figure 2 - Google Earth

Figure 3 – New South Wales Police

Abstract

On 18 March 2008, at approximately 1115 Eastern Daylight-saving Time, a Pitts S-2A aircraft struck two trees before impacting the ground beside the Northern Road, 7 km north-east of Camden, NSW, fatally injuring the occupant of the rear cockpit.

The occupant of the rear cockpit (the candidate), an experienced aerobatic pilot, was undergoing a routine flight review with an instructor. In the instructor's judgment, the candidate flew well during the flight review until a practice forced landing (PFL) manouvre just before the accident.

During the PFL, the candidate stopped responding to instructions and commands, so the instructor took control of the aircraft. A powerful nose-up force began acting on the control column and, despite the instructor's efforts to control the aircraft, it entered an incipient aerodynamic stall. The instructor recovered the aircraft from the stall but, as consequence of the nose-up force, this came too late to prevent a collision with trees.

No evidence of any mechanical problem with the aircraft was found. Post mortem examination of the candidate found he had severe heart disease.

Expert medical opinion considered it likely that the candidate suffered an incapacitating event as a result of his heart disease, and that the incapacitating event probably led to him exerting a force on the control column. The nose-up force prevented complete control by the instructor, delayed recovery from the stall, and led to the impact with trees.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external organisations.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

FACTUAL INFORMATION

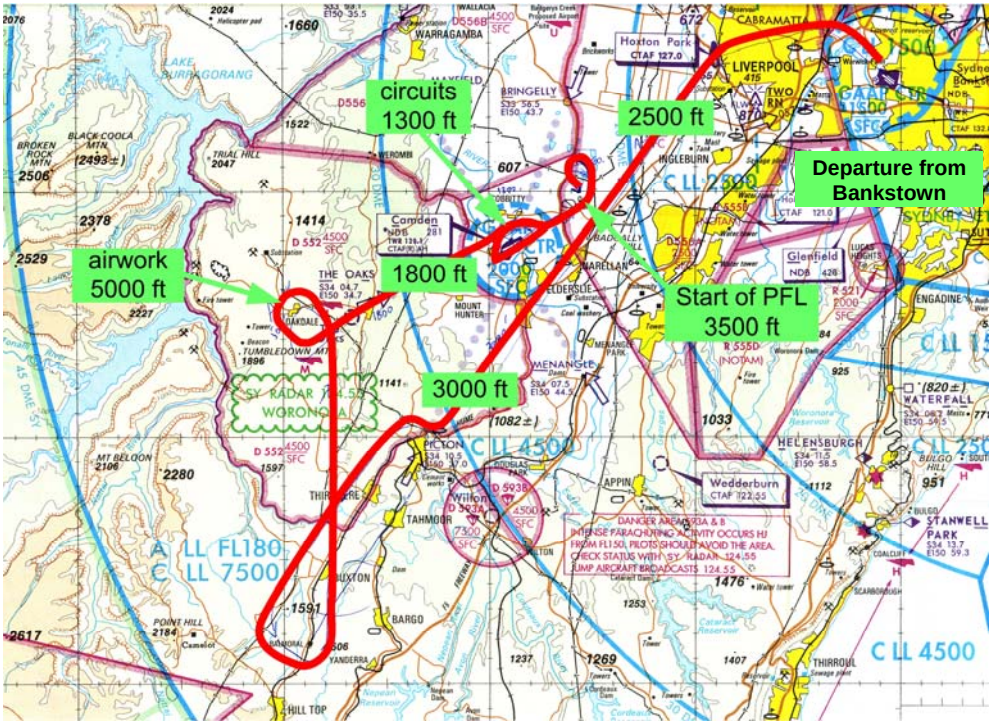
History of the flight

On 18 March 2008, a Pitts Aviation Enterprises S-2A biplane, registered VH-NUK, was being operated under the visual flight rules (VFR) and outside controlled airspace during a routine flight review[1]. Weather conditions in the area at the time of the accident flight were fine, with light northerly winds.

At approximately 1030 Eastern Daylight-saving Time[2], the aircraft departed Bankstown Airport, NSW. On board was the flying instructor conducting the review and the pilot under review (the candidate). The instructor was seated in the forward cockpit and the candidate in the rear cockpit.

The instructor's recollection of the entire flight track was corroborated by a review of available radar data (Figure 1).

Figure 1: Route taken on the accident flight



The instructor recounted that, after departing from Bankstown, the aircraft passed overhead Hoxton Park at 2,500 ft. From overhead Hoxton Park, the candidate navigated at 3,000 ft to the village of Balmoral. On reaching Balmoral, the

1 Every 2 years, Private Pilot (Aeroplane) Licence holders are required to undergo a flight review, during which their competency is assessed to ensure they are maintaining the standard required to exercise the privileges of their licence.

2 The 24-hour clock is used in this report. Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

instructor asked the candidate to make a left turn and track north to The Oaks airstrip to conduct airwork consisting of steep turns (at 60 degrees of bank angle) and recovery of the aircraft from unusual attitudes.

The candidate executed the airwork manoeuvres very competently in the instructor's opinion. Once these manoeuvres had been completed, the candidate tracked to overhead The Oaks airstrip and from there to Camden Airport to conduct circuits.

Following two uneventful circuits in light winds, they departed and climbed away to the east-north-east. After passing Oran Park racetrack, the instructor asked the candidate to track for 2RN (the Radio National transmission masts). This would have placed them on a more northerly track, heading towards fields the instructor knew were suitable for the conduct of practice forced landings (PFLs), near an area known to local pilots as the 'L-shaped lakes'. Shortly afterwards, at about 3,500 ft, the instructor closed the throttle to simulate an engine failure and said 'practice engine failure'.

The candidate lowered the aircraft's nose to establish a glide[3]. Although the instructor expected to be told promptly which field the candidate had selected as his aiming-point for the PFL, there was no comment from the candidate.

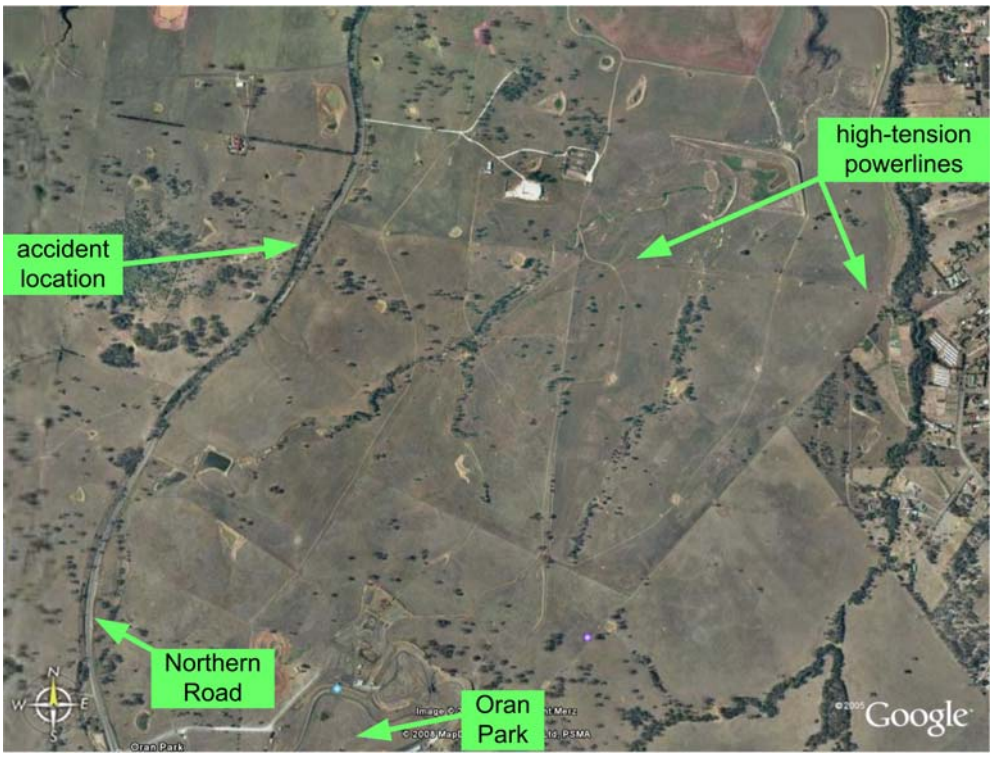
The instructor asked the candidate to state his intentions and he replied that he was aiming for a field off the left wing (the fields the instructor had in mind when he asked the candidate to track towards 2RN, and which he considered to be more suitable, were to the aircraft's right.) Given the aircraft's position when the candidate replied, the aircraft would have to fly across a line of high-tension powerlines running approximately south-east/north-west (Figure 2) to reach the aiming point selected by the candidate.

The instructor asked the candidate if he had seen the powerlines, but there was no reply. The instructor again asked the candidate to confirm that he had seen the powerlines and the candidate replied that he had seen them.

The candidate's choice of aiming point required a left turn onto final approach into the field, once the powerlines had been crossed. While the aircraft was in this turn, the instructor assessed that the aircraft's flight path would not give it sufficient clearance from some trees (which the aircraft later struck) and gave the instruction to 'go around' i.e. apply full engine power and climb. There was no response from the candidate.

3 The design of the Pitts S-2A gives the aircraft a very high rate of descent in a glide; approximately 1,500 fpm or one-and-a-half times to twice the rate for most light aircraft.

Figure 2: Accident location



The instructor called again for engine power and again there was no response. the aircraft's speed began to decrease. The instructor quickly applied full power recalled that he felt the control column begin to move backwards.

To counteract the force causing the control column to move backwards, the instructor had to use both hands and was thus unable to press the intercom button on the throttle to speak to the candidate. It required all of the instructor's strength to counteract the force which was causing the control column to move backwards.

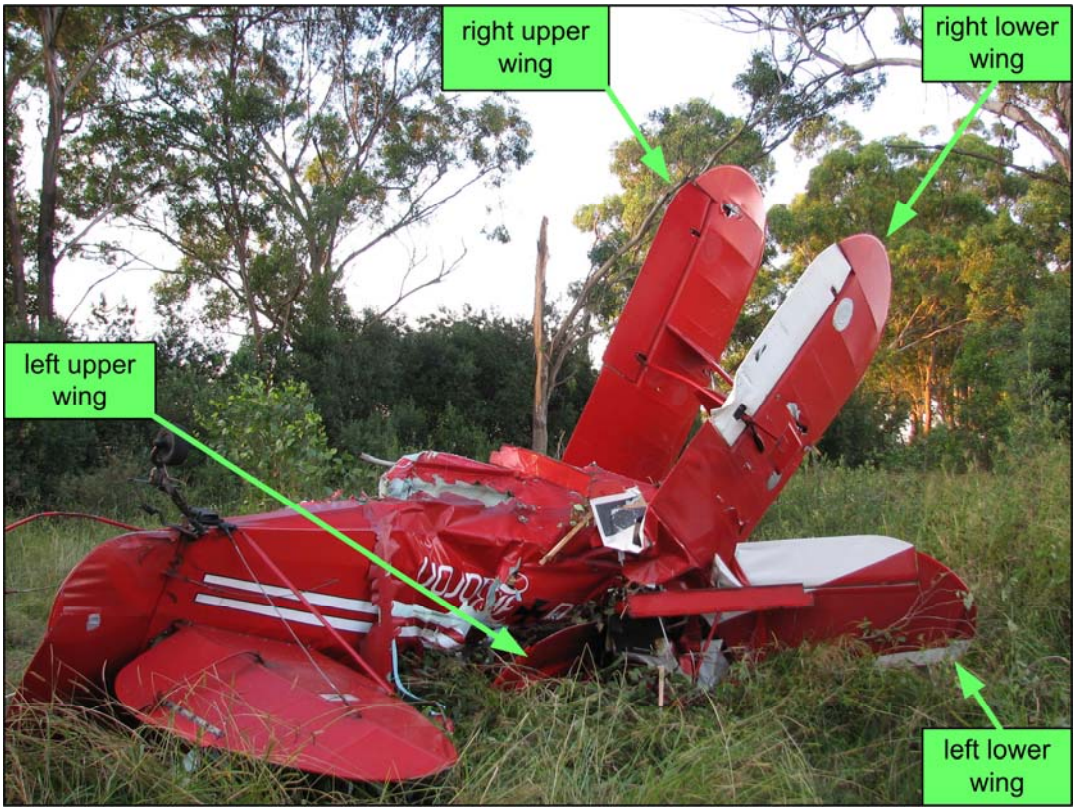
The instructor felt the aircraft begin to stall and applied right rudder to prevent the left wing dropping. He recalled feeling the aircraft recover from the stall, but that the recovery came too late to avert an impact with trees in the fence line beside the Northern Road. The aircraft struck two trees and impacted the ground between the fence line and the road, coming to rest after turning through almost 180 degrees to face its point of entry to the accident site, and with the fuselage twisted anti-clockwise with respect to the wings (Figures 3 and 4).

Immediately after the accident, the instructor pulled himself free of the wreckage. Medical assistance arrived quickly at the scene and it was determined that the candidate was deceased.

Figure 3: Crash site and aircraft wreckage

Photo courtesy of NSW Police

Figure 4: Aircraft wreckage



Pilot information

The pilot under review (the candidate) held a Private Pilot (Aeroplane) Licence (PPL) since April 2006. He had flown on a Student Pilot Licence since August 1995[4] and had accumulated approximately 520 flying hours. He was an accomplished aerobatic pilot who had competed in aerobatics events at the national level and his Class 2 aviation medical certificate was valid until 26 February 2009.

Post-mortem examination of the candidate identified significant coronary artery disease and enlargement of the heart. During the post-mortem examination, it was noted that there was relatively little internal bleeding, despite severe internal injuries.

An unpublished study[5], presented in 2006 at the Annual Scientific Meeting of the Australasian Society of Aviation Medicine, considered the predictive value of pilot medicals in identifying potential incapacitation. It found that of 61 aviation fatalities with current Australian aviation medical certificates, only two (3 per cent) were endorsed on the basis of coronary heart disease. Post-mortem examination found that nine (15 per cent) had coronary artery disease classified as 'severe'. The study concluded that coronary artery disease was significantly under-diagnosed during routine aviation medicals.

Toxicological testing revealed evidence of recent cannabis consumption, but no pharmacologically active cannabinoids.

The instructor held a Commercial Pilot (Aeroplane) Licence since 1997. He held a multi-engine command instrument rating, a grade 1 instructor rating and an approval to conduct aerobatics down to 1,000 ft above ground level. His Class 1 medical certificate was valid until 23 December 2008. He had accumulated approximately 4,800 flying hours, comprising mainly flight instruction and sport aviation, of which approximately 17 hours were in the Pitts S-2A. His commercial flying had all been conducted as an employee of the operator of VH-NUK and he was the Chief Flying Instructor.

Aircraft information

The aircraft was manufactured in the US in 1976. It was powered by a Lycoming 200 hp engine and fitted with a constant-speed two-bladed propeller. It was first registered in Australia on 23 February 1993 and was transferred to the current registration holder in November 2005. The aircraft had accumulated an estimated 2,507 flying hours at the time of the accident.

The last periodic maintenance inspection had been completed on 21 September 2007 and the aircraft's Maintenance Release was valid to 22 September 2008. The last recorded maintenance on the aircraft was Airworthiness Directive AD/FSM/31, comprising an inspection of the engine fuel injection servo plug. That was carried out on 14 March 2008 and no defects were recorded.

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4 It is quite common for pilots interested solely in aerobatic flying to operate on a student pilot licence for extended periods, often for many years.

5 By Dr Johan Duflou, Department of Forensic Medicine, NSW Health.

It is not known if the pilot had refuelled the aircraft prior to the accident flight. The cap of the main fuel tank had been dislodged during the accident and fuel had leaked out as a result. The fuel quantity at the time of the accident could not be determined, although the amount remaining in the tank after the accident would have been sufficient for continued engine operation.

The design of the Pitts S-2A is such that the pilot in the front cockpit has less mechanical advantage on the control column and rudder pedals than the pilot in the rear cockpit. The reasons for this are:

- the distance between the control column and the seat back is different in the two cockpits, being greater in the rear cockpit
- the seat back in the rear cockpit is less upright than the seat back in the front cockpit.

Wreckage and accident site information

The terrain at the accident site was flat and surrounded by trees (Figures 2 and 3). The aircraft came to rest facing back along the flight path, with the fuselage partly inverted and resting on its left side. The rear right side of the fuselage, in the area where the candidate was seated, had been broken open by impact forces.

The fuselage had twisted anti-clockwise relative to the wing structure (Figure 4). Both the right upper and right lower wings were substantially intact and pointing upwards. The left lower wing had been bent underneath and across the fuselage. The left upper wing had been bent backwards beneath the fuselage.

The right tailplane, elevator and trim tab had mostly detached from the aircraft and were located among broken branches on the ground approximately 5 m from the nose of the aircraft. The elevator and tailplane were held together by the trim tab rod.

Continuity of all flight controls, from both front and rear cockpits, was established at the site. The rudder cable on the right side of the fuselage in the vicinity of the rear cockpit had been severed by impact forces. There was no evidence of cutting or corrosion on the cable. Although both aileron input rods attached to the cockpit controls were broken, control continuity was established for all ailerons. There was full and free movement of the elevator and trim controls from both cockpits.

Continuity of engine and propeller controls was established from both cockpits. The controls were stiff and their range of movement was restricted because the engine and the engine mounts had moved rearward as the result of the impact. The throttle was in the maximum power position (fully forward) in both cockpits.

The propeller and spinner exhibited rotational and impact damage consistent with having struck trees and the ground, and some fallen tree branches showed evidence of damage from the propeller.

The intercom system was tested at the site for operation and continuity of wiring. The intercom and headsets were found to be serviceable. During the radio and intercom checks, the aircraft battery's capacity was tested and found to be 12.8 V.

ANALYSIS

A routine flight review in a Pitts S-2A, conducted by an experienced instructor and a competent candidate who was familiar with the aircraft type, ended in a collision with trees towards the end of a practice forced landing (PFL) sequence. During the PFL, the candidate stopped responding to the instructor's commands over the aircraft's intercom. The instructor tried to take control, but was impeded by a powerful rearwards force on the control column, which would have led to a full aerodynamic stall if unopposed. The instructor was able to overcome the rearwards force and recovered the aircraft from an incipient stall, but was unable to avoid a collision with trees.

The most likely explanation for the rearwards movement of the control column must involve either the aircraft and its serviceability, or the pilot under review (the candidate). There was no evidence of any mechanical problem with VH-NUK, or of any restriction or jamming of the controls, and the aircraft intercom was tested and found to be functioning correctly.

The candidate was an accomplished aerobatic pilot and had flown very well during the accident flight until the PFL. During the PFL, the instructor had to prompt the candidate three times for a response to a question or command. The first and second times, the candidate responded to the instructor's question after being prompted. The third time, the candidate did not respond to the instructor's command, and the instructor took control of the aircraft. This unresponsiveness, after an otherwise competently executed flight, is consistent with the onset of mental and/or physical impairment.

No clinically evident heart disease had been identified during the candidate's routine aviation medical examinations, but the post-mortem examination revealed significant coronary artery disease and enlargement of the heart. In addition, the post-mortem found a relatively small amount of internal bleeding, despite severe internal injuries from the impact. Taken together, these findings make it likely that the candidate suffered an incapacitating event as a result of his heart disease, and that reduced cardiac output during the impact sequence led to the relatively small amount of internal bleeding. Expert medical opinion was that the incapacitating event probably led to the candidate exerting a force on the control column which prevented complete control of the aircraft by the instructor.Toxicological testing conducted after the post-mortem examination revealed that the candidate had recently used cannabis, although expert medical opinion did not consider this recent use to have played a direct role in the development of the accident.

The design of the Pitts S-2A gave the pilot in the front cockpit less mechanical advantage on the control column and rudder pedals than the pilot in the rear cockpit. This was due to the geometry of the seats in relation to the control positions and provided the rear cockpit pilot greater leverage on the controls.

Taken together, the difference in geometry between the two cockpits gave the instructor (in the front cockpit) less mechanical advantage on the controls than the candidate (in the rear cockpit). This explains the difficulty the instructor had in opposing the candidate's control input and the need for him to use both hands to accomplish this, which in turn, rendered communication via the intercom impossible because the push-to-talk button was on the throttle.

While the instructor succeeded in recovering the aircraft from an incipient stall, this came too late to prevent a collision with trees in the fence line beside the Northern Road. The difficulty experienced by the instructor in opposing the candidate's control input delayed the recovery from the incipient stall.

FINDINGS

From the evidence available, the following findings are made with respect to the collision with terrain involving the Pitts Aviation Enterprises S-2A biplane, registered VH-NUK, on 18 March 2008 and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- The pilot under review (candidate) had significant coronary artery disease and enlargement of the heart.
- In the final stages of a practice forced landing, the pilot under review (candidate) probably experienced an incapacitating cardiac event, leading him to make a sustained and powerful nose-up control input.
- The design of the Pitts S-2A made it difficult for the instructor to override the control input made by the pilot under review (candidate), delaying the recovery from an incipient stall until it was too late to avoid a collision with trees.

Other key findings

- Routine aviation medical examination did not identify the existence of severe heart disease in the pilot under review (candidate).

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of information

Flight instructor of VH-NUK

Aircraft operator

Office of the State Coroner - NSW

Designated Aviation Medical Examiner (DAME)

Civil Aviation Safety Authority

Airservices Australia

Pilot and aircraft documentation

References

2006, DeFlou J. An unpublished study, presented at the Annual Scientific Meeting of the Australasian Society of Aviation Medicine.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the Civil Aviation Safety Authority, the aircraft operator, the Designated Aviation Medical Examiner, NSW State Coroner's office and the next-of-kin of the deceased. Submissions were received from the next-of-kin of the deceased and the Office of the State Coroner – NSW. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.