Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report – 200601688

Final

Engine power loss – Bankstown Airport – 5 April 2006

VH-ZNZ

Amateur-built Lancair 360

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

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
200601688	21 February 2007	32	1 921164 46 8

Publication title

Engine power loss – Bankstown Airport – 5 April 2006, Amateur built Lancair 360

Prepared by

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Acknowledgements

Figures 1 and 2: Google Earth

Figures 5 and 6: VH-ZNZ owner

Abstract

On 5 April 2006, the pilot of an amateur-built Lancair 360 aircraft, registered VH-ZNZ, was conducting circuits at Bankstown Airport, NSW. It was the aircraft’s first flight since being repaired after a landing accident in 2003.

Following an overflight and a touch-and-go, the pilot conducted another touch-and-go and shortly after lift-off, at an altitude estimated by witnesses to be between 100 ft and 400 ft, the engine was heard to malfunction. Almost immediately, while still not above 500 ft, the aircraft rolled into a steep right turn. Engine power was heard to return, but sounded intermittent. After turning approximately 90 degrees, the aircraft rolled out of the turn momentarily to about wings level, before the turn steepened again to the right. The aircraft was observed to roll further to the right and descend steeply. The aircraft impacted a taxiway, the pilot was fatally injured and the aircraft destroyed.

The investigation found that the engine power loss was probably due to interruptions of fuel flow to the engine, but could not conclusively determine the reason. The aircraft stalled at a height insufficient to allow the pilot to recover.

The investigation identified a number of safety issues related to stall warning, management of incomplete engine power loss after takeoff, pilot transition training and the provision of information to purchasers of amateur-built aircraft.

Following the occurrence, the Civil Aviation Safety Authority and Sport Aircraft Association of Australia implemented a number of safety actions. As a result of this and other occurrences the Australian Transport Safety Bureau initiated a broader investigation into loss of control following engine power loss after takeoff.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

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

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. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances in order to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. 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.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau prefers to report positive safety action in its final reports rather than making formal recommendations. Recommendations may be issued in conjunction with ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

FACTUAL INFORMATION

Sequence of events

On 5 April 2006, the pilot of an amateur-built Lancair 360[1] aircraft, registered VH - ZNZ, was conducting visual flight rules circuits at Bankstown Airport, NSW. The aircraft had been repaired following a landing accident in 2003, and circuits were planned to check the operation of the aircraft.

The pilot began the circuits on runway 29 Centre and was airborne at about 1429 Eastern Standard Time[2]. The pilot conducted a right circuit at 1,500 ft AMSL[3] and overflew runway 29 Right (29R) at 1,500 ft as planned.

The pilot completed another right circuit at 1,500 ft followed by a touch-and-go[4] on runway 29R. Witnesses who observed the initial takeoff and the touch-and-go, reported that aircraft performance appeared normal and the aircraft engine sounded 'fine'.

Following the touch-and-go the pilot requested another touch-and-go, which was approved by the aerodrome controller for runway 29R, with instructions for a right circuit at 1,000 ft. The aircraft was observed to touch down and lift off at the same approximate positions as the previous touch-and-go, but instead of climbing out as it had previously, it levelled out at a low altitude and accelerated along the runway. At about the end of the runway the aircraft nose was observed to pitch up into a normal climb angle and the aircraft began to climb quickly.

At an altitude estimated by witnesses to be between 100 ft and 400 ft, engine malfunction noises variously described as coughing, spluttering or surging were heard. Some witnesses described hearing an engine power loss consistent with an abrupt throttle reduction. Almost immediately, while still below 500 ft, the aircraft rolled into a steep right turn. Engine power was heard to return, but it was intermittent, and the engine was spluttering and backfiring. Aircraft maintenance engineers who heard the engine noise associated it with fuel starvation[5]. After turning approximately 90 degrees, the aircraft rolled out of the turn momentarily to about wings level, before the turn steepened again to the right. The aircraft appeared to manoeuvre within the airport boundary. A radio broadcast made by the pilot was over-transmitted by another station so that the only understandable words were '… engine problem zulu november zulu[6]'. There were no further radio transmissions from or to the pilot.

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1 The aircraft was built from a kit supplied by Neico Aviation Incorporated.

2 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. EST was Coordinated Universal Time (UTC) + 10 hours.

3 Above Mean Sea Level. Bankstown Airport is 29 ft AMSL.

4 Landing practice during which an aircraft does not make a full stop after a landing, but proceeds immediately to another take-off.

5 Fuel in tanks is for some reason prevented from reaching the engine.

6 Aircraft callsign in the International Civil Aviation Organization phonetic alphabet.

At a position corresponding to an early downwind position of a very close circuit and at a height not above 500 ft, the turn was seen to quickly steepen and the aircraft's nose dropped into a steep descent. The majority of witnesses reported that the engine noise ceased at about the same time. When close to the ground, the aircraft's nose was seen to rise and the wings move towards level, but the rapid descent continued and the aircraft heavily impacted a taxiway on the north-western part of the airport (figure 1). The pilot was fatally injured and the aircraft was destroyed.

Figure 1: Accident location at Bankstown Airport

Operating environment

Bankstown airport, located within the Sydney metropolitan area, is the main general aviation airport in the Sydney basin. At the time of the accident there were three parallel runways orientated in a north-west/south-east direction. Runway 29R was 1,100 m long.

In figure 2 the extended centreline of runway 29R is depicted as a series of dots and the accident site as a star. Outside the airport boundary, the area adjacent to the extended centre line of runway 29R was generally populated with houses and was bounded by a river. To the left of the extended centreline was a non-populated area and golf course, also bounded by the river.

Figure 2: Area to north-west of Bankstown Airport

Meteorological information

Digital images recorded of the aircraft in the circuit area and witness information indicated that there was no significant cloud in the vicinity of Bankstown Airport and the visibility exceeded 10 km.

The Bankstown Airport automatic weather station recorded observations at 1-minute intervals. On the last circuit, at the aircraft's approximate downwind position, the wind was recorded as 281 degrees true and was 14 kts gusting to 17 kts. At the approximate time of the touch-and-go the wind was recorded as 281 degrees true and was 13 kts gusting to 19 kts. At the time of the over-transmitted emergency call the wind was 303 degrees true and 10 kts gusting to 12 kts. The recorded air temperature was about 32 degrees Celsius.

Wreckage and impact information

The aircraft impacted the surface of the taxiway upright in a slightly right-wing down, nose-down attitude with indications of right yaw. The aircraft skidded along the taxiway and adjacent grass in the approximate direction of flight, colliding with the nose of a parked twin-engine aircraft before coming to rest 65 metres from the impact point (figure 3).

An oily residue in the accident trail indicated that oil had spilled from the engine crankcase. Discolouration at the initial impact site showed a quantity of fuel had spilled from the right wing tank and little fuel had spilled from the left wing tank. Further along the accident trail there was discolouration on the taxiway consistent with further fuel spillage.

Figure 3: Impact marks on airport taxiway (wreckage circled)

All of the aircraft parts were located at the accident site and examination of the wreckage showed no pre-impact structural or flight control defects. The outer wings and tail section detached during the accident sequence and the fuselage structure was broken in a number of places (figure 4). The aircraft's fuel tanks were ruptured and there was no fuel able to be recovered from the aircraft.

Figure 4: Aircraft wreckage

The investigation found the fuel selector in the MAIN (header tank) position, but an emergency worker later reported that he had moved the selector in a clockwise direction to what he thought was OFF. At the time of impact the fuel selector was probably selected to the LEFT position. The fuel boost pump switch and fuel transfer pump switch were severely damaged and their position at impact could not be established. The key aircraft fuel system components and the engine/propeller assembly were tested and/or examined, with no evidence of any pre-impact defects. Although impact damage to the carburettor prevented a comprehensive assessment, there was no evidence of a blockage, contamination or sub-component failure. The fuel filter and strainers were free of contamination and the fuel lines were unobstructed.

Testing of the propeller governor (constant speed unit) indicated that the maximum engine speed was set to about 2930 RPM instead of the 2700 RPM specified for this engine type. Maintenance worksheets dated 14 March 2006 recorded the maximum static[7] RPM as 2520 RPM. That was less than the 2600-2650 maximum static RPM range specified by the propeller manufacturer and was probably due to the propeller fine pitch stop setting.[8] The maximum RPM recorded by the electronic tachometer fitted to the aircraft was 2720, indicating that during the circuits the engine RPM was propeller pitch limited rather than governor limited.

Specific aircraft information

The aircraft was constructed by an owner-builder in Western Australia from a kit purchased from the manufacturer in the US. The builder fitted a type-certified[9] Textron Lycoming O-360 engine and type-certified MT-Propeller MTV-12 variable pitch propeller. The kit did not contain a stall warning device and the builder did not fit one. There was no regulatory requirement for a stall warning device.

The builder reported that the aircraft was constructed in accordance with the kit plans except for a few changes that included modifying the fuel system. In the standard fuel system, a header tank located between the cockpit and engine was the only tank that supplied fuel to the engine. When the header tank quantity decreased, the pilot transferred fuel from the left or right wing tank to the header tank by activating electric pumps. The builder reported that he had been concerned that with a standard fuel system, a pilot could forget about the need to transfer fuel to the header tank.

The builder modified the standard fuel system by incorporating a fuel selector (figure 5) and fuel lines that allowed the engine to be supplied directly from the header tank or either wing tank. An electric pump and fuel lines were also fitted to allow transfer of fuel from the left wing tank to the header tank. The header tank had a maximum capacity of 41 L and each wing tank had a maximum capacity of 80 L.

The aircraft builder reported that he operated the aircraft with the header tank selected for takeoff and climb, and selected a wing tank during the cruise phase of flight. Information relating to the nature of the modification and the proposed method of operation was not included in any aircraft documentation.

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7 Aircraft is stationary.

8 A fine pitch stop that is set at a higher-than-required propeller pitch acts in a similar way to a higher gear in a motor vehicle, which at low forward speed produces more load on the engine and limits its RPM. Once an aircraft accelerates during a takeoff roll, the propeller unloads and allows the engine speed to increase.

9 Verification that aircraft or major component meets a recognised airworthiness standard.

The aircraft was equipped with a plastic-tube sight gauge as the header tank fuel quantity indicator. The fuel level evident in the plastic tube corresponded with the quantity of fuel in the header tank. There were marks identified adjacent to the plastic tube, but no scale marked. An electronic instrument provided fuel quantity indications for the left or right tank.

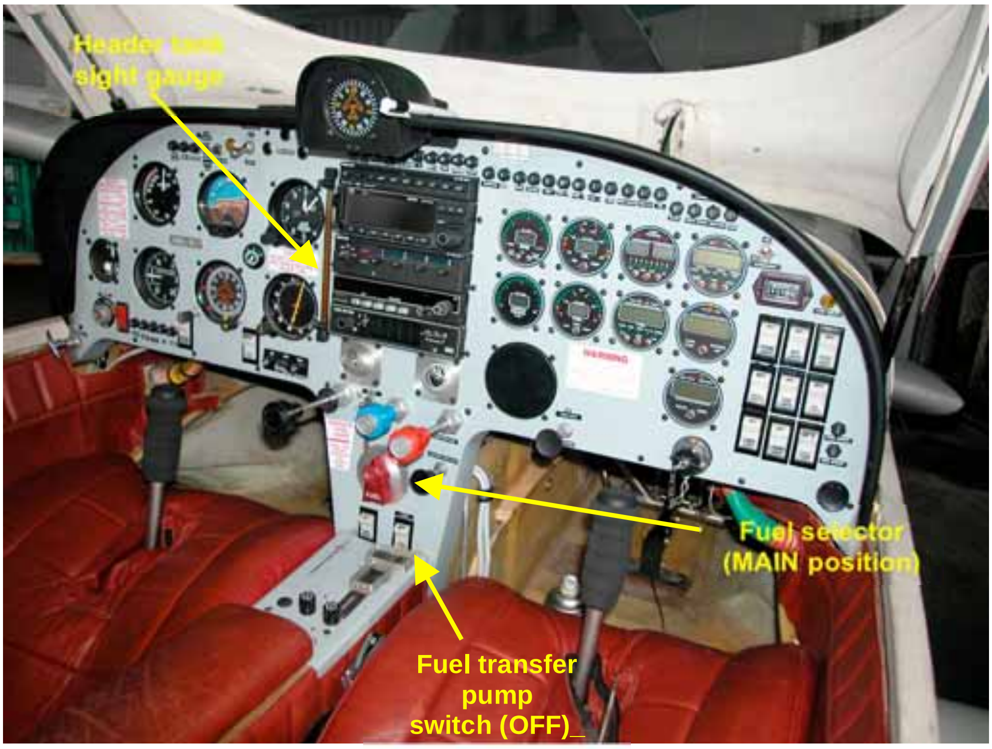
A copy of the *Pilot's Operating Handbook and Airplane Flight Manual* (POH/AFM) produced by the kit manufacturer for Lancair 235, 320 and 360 aircraft was carried in the aircraft. It contained the following fuel management information:

> Do not takeoff with less than 8 gallons [30 L][10] in the header tank. Since the engine is supplied fuel solely from the header tank, fuel must be transferred from each wing tank to the header tank periodically

The minimum fuel instruction was also placarded on the aircraft's instrument panel (figure 6). According to the aircraft kit manufacturer, the 8 gallon minimum for takeoff was to ensure that pilot had adequate fuel for takeoff and climb, and was to keep the aircraft within centre of gravity limits.

The POH/AFM fuel management information and instrument panel placard did not apply to the system in VH-ZNZ because fuel was not supplied solely from the header tank.

Figure 5: Aircraft cockpit and instrument panel (14 March 2006)



An authorised person (see 'Operation of amateur-built aircraft' below) issued an experimental certificate for the aircraft in November 2000 for test flying only. An experienced pilot conducted the first stage of the test flying, which was completed

10 Added for clarification – not in the POH/AFM.

by the builder. There was no record of aircraft stall performance from that test flying.

In August 2001, the builder certified that the aircraft met the necessary handling requirements and the geographic limitations related to the test flying were lifted. Conditions on the experimental certificate included:

> 5. Except for take-off and landing, or when following a prescribed procedure, no person may operate this aircraft over the densely populated area of a city or town unless so authorised by CASA or an authorised person.
>
> 6. Except as permitted by limitation (5) above, flight over any persons or dwellings shall be at such a combination of height and speed as to permit the pilot to glide clear of all persons and dwellings, in event of an engine failure or other flight critical emergency.

In November 2002, the builder sold the aircraft. The builder advised that he had not encountered any difficulties in operating the aircraft. The accident pilot ferried the aircraft from Western Australia to Bankstown Airport.

During a flight on 15 July 2003, the nose landing gear did not extend and the owner landed at Bankstown Airport on the main wheels, resulting in significant damage to the propeller and right wing. The Civil Aviation Safety Authority (CASA) suspended the experimental certificate.

The aircraft was inspected and repaired at a CASA-approved maintenance facility in accordance with approved data. The accident pilot performed the majority of the repair and maintenance work carried out on the aircraft. During the repair the aircraft was sold.

An engine crankshaft runout and flange inspection was carried out with no recorded defects. A new MT propeller was installed. Following the repair, a periodic inspection was carried out in accordance with Civil Aviation Regulation Schedule 5. Maintenance staff reported that the accident pilot carried out a number of engine ground runs with no indication of any defects. CASA lifted the suspension on the experimental certificate on 31 March 2006. The previous maintenance release had been lost and the total time in service was calculated to be 80.5 hours. There were no defects annotated on the newly issued maintenance release and the accident flight was the first flight since the repair.

The aircraft was calculated to be 50 kg below maximum take-off weight and within centre of gravity limits.

Aircraft fuel situation

The owner of the aircraft recorded digital images of the aircraft instrument panel on 10 January 2006 and 14 March 2006 (figure 6). The images showed that on both days, the aircraft's fuel selector was selected to the MAIN position (header). The fuel level on the sight gauge had reduced from about 30 L in the January image to about 20 L in the March image.

Figure 6: Header tank quantity indications

10 January 2006 **14 March 2006**

There was no reliable evidence of tank selection or header tank quantity after 14 March 2006. Although there were reports of engine ground running after that date, the reports were not detailed or consistent. As a result, the investigation was unable to accurately determine the quantity of fuel consumed since 14 March 2006.

Five days before the accident, the wing tanks were drained (not including the header tank), and refilled with a total of 160 L of Avgas from a mobile tanker to calibrate the wing tank quantity indication system. The calibration was supervised by the accident pilot who was assisted by a maintenance engineer in the cockpit. The engineer recalled that the pilot did not require fuel to be added to the header tank, but he could not recall the header tank quantity at the time. A number of aircraft had been refuelled from the same fuel source and there were no reports of any fuel-related engine malfunctions.

Maintenance staff reported that, after the fuel calibration, the aircraft engine was not operated until the accident day. On the morning of the accident day the pilot conducted an engine ground run for about 25 minutes. On return, the pilot arranged for maintenance staff to drain 20 L from each wing tank, reportedly to lighten the aircraft. There was no reliable information regarding the quantity of fuel in the header tank or remaining in the wing tanks.

The only recorded fuelling of the aircraft after 14 March 2006 was the fuel calibration five days before the accident. Based on a number of assumptions about fuel selection and ground-running fuel consumption after 14 March 2006, and not allowing for fuel transfer from the left wing tank to the header tank, the investigation derived eight possible fuel conditions at impact. Four of those eight conditions featured zero or very low quantities of fuel in the header tank, including the default scenario of continued header tank selection after 14 March 2006. The lowest derived fuel quantity in a wing tank was 40 L.

When the possibility of internal transfer of fuel from the left wing tank to the header tank was factored into the scenarios, that produced the eight conditions, there was one possible condition where the left fuel tank quantity was reduced to 15 to 20 L.

Pilot information

In 1999, CASA issued the pilot with a private pilot (aeroplane) licence. In 2002, the pilot qualified for constant speed propeller, retractable undercarriage and single engine (piston) aeroplanes below 5,700 kg endorsements. Later in 2002, CASA issued the pilot with a commercial pilot (aeroplane) licence and Grade 3 instructor rating. In May 2005, the pilot was issued with a Grade 1 Instructor rating.

Since June 2002, the pilot had been instructing at a Bankstown Airport flying school in Grob 115 (T-Bird) and EADS Socata Tobago (TB-10) aircraft. The most recent flight instructor proficiency check was conducted in a Grob 115 on 16 July 2005. Although the pilot's logbook did not contain any record of flights after 21 July 2005, other records and reports indicated that he had flown regularly after that date and a total recorded flying experience of 1,728 hours was established.

In late 1999, the pilot had undergone aerobatic training in Cessna 152 aircraft and was approved to conduct loops, barrel rolls, aileron rolls, stall turns, spins and combinations thereof. In July 2002, the pilot was checked out by the flight school in a R2160 (Robin) aircraft and had since conducted about 10 hours of aerobatic trial instructional flights (TIFs). The last aerobatic TIF was recorded in March 2003. The pilot had recorded a 20 hours of aerobatics.

Prior to the accident flight the pilot had recorded 50.5 hours in Lancair 320 or 360 aircraft. The pilot's first recorded flight in a Lancair was the ferry of VH-ZNZ from Western Australia to Sydney in November 2002. At that time, the pilot held a Grade 3 instructor rating and had logged about 556 total flight hours. Subsequent Lancair experience consisted of instructing owner-pilots in their Lancairs on a sporadic basis. The most recent Lancair flying was in February 2006 when the pilot instructed the new owner of a Lancair for about 8 flight hours.

In 2001, the pilot was flying an ultralight-registered Jabiru aircraft when it sustained an engine failure soon after takeoff at Wedderburn Airfield, south-east of Sydney. The event was described in a *Flight Safety Australia* article by an ultralight instructor pilot who was in the Jabiru and observed the pilot manage the emergency. The analysis of the event by staff writers included the following comments:

> Rather than attempting to return to the field (which can present a strong temptation to a flustered pilot in this situation even though it is usually impossible), this pilot responded correctly and capably by lowering the nose and preparing for a crash landing, having assessed that course as the only viable option that was available.

The pilot held a valid Class 1 medical certificate with a requirement for distance vision correction to be worn while flying. A pair of spectacles was found in the wreckage.

People in contact with the pilot on the day of the accident reported that he appeared to be in good health and they did not notice anything abnormal. Post mortem and pathology reports found no evidence of any medical factor that may have impaired the pilot's performance during the flight.

The pilot had an aircraft maintenance background and in the few years prior to the accident had been working as an aviation maintenance engineer at the approved maintenance facility where the accident aircraft was repaired.

Pilot requirements re different aircraft types

The pilot of a single engine (piston) aeroplane below 5,700 kg maximum take-off weight requires a class endorsement and any applicable special design feature endorsements to act as pilot in command.

In addition, a pilot must also comply with the requirements of Civil Aviation Order (CAO) 40.1.0 section 4.4, which stated:

> The holder of a class endorsement must not fly as pilot in command or co-pilot of any aeroplane unless he or she:
>
> (a) is familiar with the systems, the normal and emergency flight manoeuvres and aircraft performance, the flight planning procedures, the weight and balance requirements and the practical application of take-off and landing charts of the aeroplane to be flown; and
>
> (b) has sufficient recent experience or training in the aeroplane type, or in a comparable type, to safely complete the proposed flight; and
>
> (c) if an aeroplane in that class has a special design feature, holds a special design feature endorsement referred to in paragraph 5.1 for that design feature.

The Civil Aviation Safety Authority did not publish formal guidance as to how to comply with the CAO requirements.

In-flight management of engine power loss

Instructional requirements

The *Day VFR Syllabus – Aeroplanes* detailed the competency requirements for the issue of private and commercial pilots' licences. The 'manage abnormal situations' units of the syllabus contained a 'manage engine failure after take-off' element. The assessment guide included the following evidence requirements:

- Action plan is determined for an engine failure after takeoff.
- Action plan includes not turning back towards airfield after engine failure unless above a safe altitude.
- Nose is immediately lowered to maintain best gliding speed.
- Suitable landing area is selected.
- Turns are minimised.

The syllabus did not specifically address the management of incomplete engine power loss.

The *Flight Instructors Manual* was produced by CASA as a guide to elementary flying training. While the ‘emergency and special procedures’ section of the manual did not specifically address engine failure after takeoff, in the context of a forced landing it recommended that:

> If the failure is partial, resulting in reduced or intermittent running, the engine may be used at the pilot’s discretion, remembering that it may pick up temporarily or fail again at a critical stage. In such a case it is probably best not to rely on the faulty engine and to assume a total failure.

It was also noted that the *Flight Instructors Manual* did not mention the desirability of the student developing a practice of preparing and self-briefing a specific action plan for engine power loss after takeoff.

A copy of the POH/AFM was carried in the aircraft. In regard to engine failure during takeoff ground roll/low altitude, the POH/AFM stated:

> Maintain control of the aircraft. If runway permits, land and attempt stop on runway. If at low altitudes (less than approximately 700 ft AGL), pick the most suitable site within +/- 30 degrees off the nose and set up the approach. If time permits, attempt engine start.

The POH/AFM did not specifically address an incomplete power loss situation.

Partial power loss and pilot decision making

A pilot faced with a partial power loss at a critical phase of flight is confronted with a particularly difficult situation to handle. On the one hand, it may be that the power loss is such that there will be no alternative but to force-land the aircraft in the best manner possible. On the other hand, it may be that sufficient power is available to allow the flight to proceed to the extent that a safe emergency landing can be carried out. A pilot will typically have only a short period of time to assess the situation and make a decision, probably based on limited and uncertain information.

In deciding how to handle a partial engine failure, it is possible that the pilot may compare the almost certain damage and possible injury that would result from a forced landing, with the possibility that if they continue the flight, they may be able to land without either damage or injury. That is, to the pilot, the decision may seem to be one between an almost certain loss, and the possibility that they can conclude the flight without either damage or injury. The risk, therefore, is that the pilot may focus on the negative consequences of a forced landing, and therefore try to avoid that at all costs, even when it would be the safest course of action in the circumstances.

Lancair flight characteristics

The generic Lancair 360 aircraft is a conventionally-configured low-wing, two-seat aircraft constructed primarily of composite material. It is a relatively high performance aircraft that can cruise at speeds in excess of 180 kts. The Lancair 360 was not type-certificated, which meant that it was not required to comply with any recognised airworthiness standards including flight handling qualities and stall warning requirements.

When Lancair aircraft were first introduced to Australia, test flying identified deficiencies in the stability and control characteristics. Modifications made to the tailplane and flight control system rigging were subsequently incorporated by the kit manufacturer.

In June 2006, as part of a CASA review of Lancair operations, the CASA test pilot conducted a desktop review of the documented performance and handling characteristics of the Lancair series of aircraft. The review conclusions included the following:

- Lancair stall speeds are somewhat higher than those of General Aviation (GA) aircraft of comparable weight
- The other general performance characteristics of the aircraft are superior to those of GA aircraft of comparable weight although take-off and landing performance may be inferior
- Later versions of the Lancair have precise, generally well-harmonised controllability and manoeuvrability characteristics
- Later versions of the Lancair have positive, although weak, stability characteristics
- The stall handling characteristics of later versions of the Lancair are essentially benign, easily controlled and repeatable although high rates of descent may be present
- Positive warning of the stall in the Lancair is best provided through installation of an artificial stall warning device
- The adequacy of the post stall and spinning behaviour of the Lancair can only be guaranteed if the aircraft was type-certified

A professional test pilot familiar with the Lancair 320/360 type of aircraft reported that the aircraft type had natural buffet commencing between 5 and 10 kts KIAS above stall, depending on the deceleration rate.

The ATSB collected information about Lancair flight characteristics from some pilots who had flown the Lancair type of aircraft. Overall, those pilots were wary of stalling the aircraft and stressed the need to maintain adequate airspeed at all times. Pilots who had stalled the aircraft described a tendency for the aircraft to drop a wing and to lose 1,500 ft or more in the recovery. Although it is not known if the accident pilot had previously stalled a Lancair, he had expressed a view that the Lancair was usually unpredictable at the stall.

The POH/AFM did not specify the stall speed, but stated that stalls should be conducted (during flight testing) in a variety of configurations to establish the particular aircraft's stall speeds. The stall speeds were then to be plotted on a chart and maximum height loss recorded. That information was not recorded in the aircraft's POH/AFM. An indicative zero-flap Lancair stall speed was reported to be 58 KCAS[11].

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11 Calibrated indicated airspeed, which is the indicated airspeed corrected for system errors.

Like any aeroplane, the Lancair stall speed will increase with increased bank angle. At 60 degrees angle of bank in a level turn the stall speed will be about 41 % higher than in wings level flight.

The POH/AFM contained the following warning regarding aerobatics:

> … [the] Lancair is a very "slick" aircraft thus speeds increase very rapidly during descents, stalls or incipient spins and you will consume great amounts of altitude during recovery.

The POH/AFM specified the best glide speed as 104 kts.

Operation of amateur-built aircraft

The occurrence of two fatal Lancair accidents in densely populated areas within five days of each other prompted a review of the operation of amateur-built aircraft in Australia.

In the Australian regulatory context, an amateur-built aircraft is defined as an aircraft the major portion of which has been fabricated and assembled by a person that undertook the construction project solely for the person's own education or recreation. In 1998, the Civil Aviation Safety Authority (CASA) introduced an experimental aircraft designation, which allowed the design, building, operation and maintenance of a variety of amateur-built aircraft in a similar way to the US. Prior to 1998, only CASA-approved aircraft designs were allowed to be amateur-built and CASA monitored each stage of the construction process.

CASA or its delegate must issue an experimental certificate to an aircraft, but is required to impose conditions that are considered necessary for the safety of other airspace users and persons on the ground or water. There is no provision for CASA or its delegate to impose conditions to safeguard the pilot or passengers. Accordingly, a placard is required in experimental aircraft that states:

> Warning Persons fly in this aircraft at their own risk. This aircraft is not operated to the same safety standards as a normal commercial passenger flight CASA does not set airworthiness standards for experimental aircraft.

An experimental certificate is not a certificate of airworthiness. Amateur-built aircraft do not have to comply with any recognised airworthiness standards including crashworthiness standards. CASA does not take any responsibility for the airworthiness of an experimental aircraft, which is the responsibility of the builder or subsequent owner.

CASA delegates the issuance of experimental certificates to specific individuals who are called authorised persons (APs). An AP is typically a Licensed Aircraft Maintenance Engineer (LAME) with extensive aviation experience. They are provided with training and are required to follow a documented process for assessing airworthiness to the extent required for issuing a certificate. CASA audits the AP processes and experimental certificates issued by APs.

Although an aircraft such as a Lancair 360 is built from a kit, the experimental designation allows a builder to make changes to the design, materials and construction technique. As a result, a completed amateur-built aircraft is considered to be a unique aircraft that may have individual operational characteristics.

Before an experimental certificate is issued, an AP will inspect the aircraft and assess its conformance to the applicable administrative requirements and its airworthiness in regard to the safety of other parties. The AP will issue an experimental certificate that only allows flight testing within a specific geographic area that is not densely populated. The flight testing period may be 25 flight hours for aircraft using a type-certificated engine/propeller combination, or 40 flight hours for a non-certificated engine/propeller combination. A number of other conditions will usually be imposed.

Once the flight testing period is complete and the owner has certified that the aircraft is controllable and has no hazardous operating characteristics or design features, the limitations related to the flight testing will usually be removed. Specific authorisation is required to operate an experimental aircraft over the built-up area of a city or town. An aircraft of a proven design built from aviation grade materials and fitted with a certified engine and propeller will typically be granted that authorisation.

If an 'experimental' aircraft is 'VH' registered, the minimum pilot qualification is a CASA-issued private pilot's licence with the appropriate endorsements. An 'experimental' aircraft must be operated in accordance with the rules and regulations that apply to certified 'VH' registered aircraft. A maximum of five passengers may be carried provided each person is informed that the design, manufacture and airworthiness of the aircraft is not required to meet any CASA standards and that they fly in the aircraft at their own risk.

The owner-builder of an experimental aircraft is authorised to perform and certify maintenance on that aircraft, or may contract a LAME. Subsequent owners are required to use a LAME or else obtain a maintenance authority to maintain their aircraft.

The owner-builder of an amateur-built aircraft is able to sell the aircraft to any person. The new owner (and any subsequent owner) of the aircraft is entitled to operate the aircraft in accordance with the original experimental certificate.

The Sport Aircraft Association of Australia Inc (SAAA)[12] is 'an active group of aviation enthusiasts supporting one another in building and flying recreational aircraft'. The SAAA provides a Flight Safety Assistance Program, which currently has three active modules covering building, test flying and maintaining amateur-built aircraft. A fourth module, a generic pilot proficiency program is planned. The SAAA coordinates all but two of the APs and produces a standard manual of operating procedures.

Accident information

Fatal Lancair accidents

On 31 March 2006, five days before the Lancair 360 accident at Bankstown, a Lancair 320 collided with terrain near Archerfield Airport, Queensland, fatally injuring the pilot. At the time of release of this report, that accident was still under investigation by the Australian Transport Safety Bureau (ATSB).

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12 Information on the Sports Aircraft Association of Australia is available at http://www.saaa.com.

Including the accident at Archerfield and this occurrence at Bankstown, there have been seven fatal Lancair accidents in Australia. The circumstances of those seven accidents indicated uncontrolled flight into terrain as a result of a stall/spin event. Engine power loss was associated with three of the accidents and two of those, including this occurrence, were soon after takeoff. More information about these accidents is available at Appendix A.

2002 Lancair accident

On 11 November 2002, the pilot of a Lancair 320 was landing at Temora, NSW. The pilot reported that he was landing in a 30 kt crosswind and sideslipped the aircraft on approach. It became difficult to maintain directional control so the pilot initiated a go-around from a low altitude. When the aircraft was at about the end of the runway at 50 ft the engine 'hiccupped'. The pilot related that he feared the engine would stop and, due to obstacles ahead and to the right, made a steep turn to the left. The engine stopped and the aircraft force-landed in a paddock. The pilot and passenger survived, but the aircraft was substantially damaged.

The ATSB did not investigate, but the aircraft and engine were examined by qualified personnel and no defects were found. The pilot reported that during the approach the right wing tank was selected (aircraft was not fitted with a header tank) and the right wing was down. The pilot concluded that the right wing fuel tank had un-ported[13] and introduced air into the fuel system that reached the engine and affected power output at about the end of the runway. The pilot had considerable aerobatic experience and had flown over 100 hours in Lancair aircraft that included aerodynamic stalls. However, he was surprised by how quickly the aircraft lost speed and directional authority following the engine power loss.

An experienced aerobatic pilot familiar with the circumstances of the Temora accident reported that he had discussed the accident with the pilot of VH-ZNZ.

Comparative accident rates

In order to better understand the relative risks associated with the operation of experimental aircraft in Australia, the ATSB calculated the accident rate for amateur-built aircraft and the accident rate for comparable certified aircraft. The data was not fully verified and is therefore indicative only.

A search of the ATSB database was conducted for accidents involving amateur-built fixed-wing single-engine aircraft below 5,700 kg MTOW occurring between 1995 and 2005 inclusive. The search yielded a total of 90 amateur-built aircraft accidents during the 11-year period, of which 12 % were fatal. That data was combined with hours-flown data from the Bureau of Transport and Regional Economics (BTRE) to produce an accident rate of 42.5 accidents per 100,000 hours flown over the 11 years.

A similar search process was conducted for accidents involving certified fixed-wing single-engine aircraft below 5,700 kg MTOW operating in the private or business category. In the same 11-year period there were 565 accidents, of which 11 % were fatal. The accident rate utilising BTRE hours-flown data was calculated to be 16.8 accidents per 100,000 hours flown for private or business purposes.

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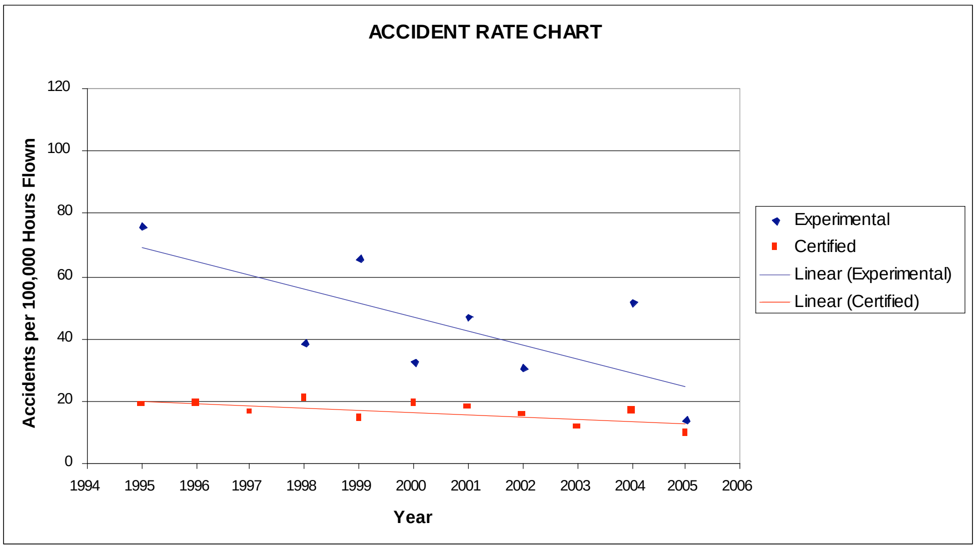
13 Un-porting is the movement of fuel in a fuel tank away from the pickup point.

Based on the unverified data in the ATSB database, it is apparent that the amateur-built fixed-wing single-engine aircraft accident rate is about 2.5 times the accident rate for comparable certified fixed-wing single-engine aircraft. However, there are factors that should be taken into account when comparing accident rates. The relatively low numbers of amateur-built aircraft means that the statistics are not as reliable and tend to produce a wider scatter. Additionally, the experimental designation covers a wide variety of amateur-built aircraft designs including some aircraft produced before the experimental designation was introduced in 1998.

The accident rates were plotted on a chart (figure 7) and a trendline derived. The trendline for amateur-built aircraft accident rates shows, that the line is converging with the accident rate trend for comparable certified fixed-wing single-engine aircraft.

Figure 7: Accident rate chart



The ATSB is considering further research of amateur-built aircraft statistics to validate the initial findings and to explore other aspects of the designation during 2007.

ATSB Research

In December 2002, the ATSB produced a research paper titled *Australian Aviation Accidents Involving Fuel Exhaustion and Starvation*. The primary focus of the study was the period 1991 to 2000. The paper included a break-down of contributing factors that listed inattention to fuel supply and mismanagement of fuel supply as contributing to 58 % of the total fuel starvation accidents. The study also found that one in four pilots involved in a fuel-related accident appears to have used inappropriate aircraft handling techniques after an engine failure was experienced.

ANALYSIS

Introduction

The investigation established that the circumstances of the occurrence were consistent with a pilot decision to conduct a tight circuit following the partial loss of engine power soon after takeoff. This analysis will discuss the potential factors in the engine power loss and pilot response, and examine a number of safety issues identified by the investigation.

Engine power loss

The examination of the engine, propeller and related systems was comprehensive and did not identify any defect that could have adversely affected the operation of the engine. Although impact damage to the carburettor prevented a complete examination, there was no indication of any pre-existing faults. The symptoms heard by the witnesses were generally consistent with operation of an engine deprived of adequate fuel. Based on the examination of the aircraft and witness information, the investigation considered that the engine power loss probably resulted from interruptions to the flow of fuel to the engine.

The investigation was unable to conclusively determine the reason for any interruptions of fuel flow to the engine. The pilot had conducted a number of engine ground runs since the repair and there was no indication that the pilot was concerned about engine operation before the last touch-and-go. There had been no reports of abnormal engine operation in other aircraft that had been refuelled from the same fuel source. Furthermore, the aircraft performance appeared normal and the engine sounded 'fine' before the power loss. The recent addition of fuel and the taxiway discolouration evident at the accident site indicated that there was a significant amount of fuel on board the aircraft. With the significant amount of ground running after the repair and the recent addition of fuel to the wing tanks, there was nothing to indicate that there was a problem with fuel quality.

The eight fuel selection scenarios derived by the investigation were based on a number of assumptions and were therefore not conclusive. Those calculations, however, did suggest that low header-tank fuel quantity and un-porting of the left tank were possibilities.

If the engine power loss was a result of low header tank fuel quantity, the header tank would have been selected at the time of the initial engine power loss and the left wing tank selection (as found in the wreckage) made by the pilot during the subsequent manoeuvring. If that was the case, it is likely that the pilot would have recognised the reason for the power loss and changed tanks.

Given that the placard on the instrument panel specified a minimum of 8 gallons (30 L) of header tank fuel for takeoff, and the header quantity indicator was centrally located, the investigation was unable to explain how an experienced pilot familiar with the aircraft may have continued to operate the engine from the header tank with low fuel quantity.

While low header tank fuel quantity provided an explanation for the engine power loss, the investigation could not rule out un-porting of the left fuel tank. It is possible that, after the wing tanks were filled five days before the accident, fuel was internally transferred from the left wing tank to the header tank and the left wing tank was selected for the ground running and accident flight. If that was the case, the left tank quantity may have been down to approximately 20 L, which is a quarter of tank capacity.

The Lancair accident at Temora in 2002 indicated possible Lancair susceptibility to un-porting of the lowered wing tank in a prolonged sideslip. In this accident, however, there was no evidence of lowered left wing or of a prolonged sideslip. The initial climb was considered to be another potential factor in any un-porting event, but there was probably insufficient time for air to be introduced at the tank pickup and to travel through the fuel system and affect engine operation.

The intermittent operation of the engine until the steep descent appears to be a continuation of the initial engine power loss. It would take time for the system to purge any air introduced into the fuel system from the header or left wing tank. There are a number of factors that could influence the time taken for air to be purged from the fuel system including fuel boost pump operation, system design and flight dynamics. It is not known if the fuel boost pump was on and the investigation was unable to determine whether the system design or steep turns had an influence on the flow of fuel to the engine.

Response to engine power loss

Taking off on runway 29R at Bankstown Airport, the pilot was in a very difficult situation when the engine abruptly lost power at a relatively low altitude near the end of the runway. Importantly, the geography of the adjacent area limited the forced landing options available to the pilot.

The steep turn after the initial power loss was not consistent with the applicable criteria in the *Day VFR Syllabus – Aeroplanes*, or the kit manufacturer's advice to pick the most suitable site within +/- 30 degrees off the nose. However, taking into account the higher-than-normal speed and intermittent availability of power, the circumstances differed to the standard engine-failure-after-takeoff situation that the pilot would have been familiar with in a flight instructional environment. The aircraft's relatively high kinetic energy when engine power was first compromised meant that some manoeuvring outside the conventional +/- 30 degrees was possible.

With the limited amount of information available, the investigation was unable to establish the pilot's objective in conducting the steep right turns. The momentary level-out after the first turn, however, indicates that the pilot was not intending to turn back to the departure runway. The pilot may have been attempting a tight circuit in the direction assigned by the aerodrome controller to limit his exposure to an off-airport landing or, after making the first right turn, was confronted with the bus depot and school and may have then decided to continue the turn.

Given the pilot's general flying and aircraft maintenance experience, he may have identified the reason for the engine power loss and corrected it, with an expectation that continuous power would be restored shortly after. Such an expectation may have been reinforced by the engine operating intermittently. By elevating the left wing in the steep turns the pilot may have been attempting to facilitate the flow of fuel from the left wing tank.

The Lancair's relatively high glide speed of 104 kts and lack of certified crashworthiness may have led the pilot to believe that, in the circumstances, a forced landing would almost certainly involve serious damage and possibly significant injury. The pilot's investment of time and effort in the aircraft repairs may also have contributed to the pilot's decision making.

Once the pilot had initiated the steep right turn, he was reliant on restoration of continuous engine power in a short period of time to maintain control. With the benefit of hindsight, a slight diversion to the left of the extended centreline would have minimised energy loss and increased the likelihood of the pilot maintaining control if engine power was not restored. While the forced landing areas available were by no means ideal and did not guarantee a successful outcome, survivability would have been maximised by maintaining control of the aircraft.

The steep turns consumed the aircraft's kinetic energy and an increased angle of attack was required to maintain height. The steepening of the turn and the nose drop are consistent with the aircraft reaching the stalling angle of attack in the second turn and aerodynamically stalling. Before the descent the aircraft was turning into a downwind component of at least 13 kts and the engine was heard by some witnesses to stop completely, both of which may have precipitated a stall. Although the pilot managed a partial recovery, there was insufficient altitude available for a full recovery.

Given the pilot's instructional background and exposure to aerobatics, it is reasonable to assume that he would have been aware of the increased susceptibility to aerodynamic stall in a steep turn, especially with reduced engine power. In the absence of a stall warning device, and in the high workload situation the pilot may not have recognised any aerodynamic indications of an impending stall until it was too late to prevent it.

It was not possible to determine if the fitment of a stall warning device to the aircraft would have changed the outcome of this occurrence. However, those devices can provide an effective warning of the onset of a stall and reduce the risk of loss of control.

Aircraft type transition requirements

The pilot held the appropriate pilot's licence and special design feature endorsements for the Lancair type of aircraft. In addition to the licence requirements, CAO 40.1.0 section 4.4 required that the pilot be familiar with the aircraft normal and emergency flight manoeuvres, and have sufficient training and recent experience on the aeroplane type, or a comparable type. There was no evidence of the pilot receiving training in a Lancair or comparable type before he flew a Lancair for the first time in 2002, and the pilot's level of familiarity with the Lancair's normal and emergency manoeuvres, including aerodynamic stall, could not be established. Nevertheless, at the time of the accident the pilot was a Grade 1 instructor who had logged 50 mainly instructional flight hours in various Lancairs over 3 or so years.

Although there was no evidence that the pilot's lack of training in a Lancair type aircraft contributed to the accident, the completion of transition training in a Lancair or comparable aircraft type would have provided a higher level of assurance that the pilot had acquired the appropriate knowledge and skill to safely manage all reasonably foreseeable situations.

The investigation considered that the provision of formal guidance as to how to comply with the CAO 40.1.0 section 4.4 requirements could emphasise the need for a risk-based approach to a pilot's transition to new aircraft types and provide the means for pilots and instructors to develop appropriate ground and flight training.

Management of engine power loss after takeoff

A partial engine power loss soon after takeoff is a very challenging situation for the pilot of a single engine aircraft. The availability of reduced power or intermittent power may be a significant risk factor in pilot decision making. The increased number of options that the availability of incomplete engine power provides, increases the complexity of the event, and makes it harder for a pilot to process information and act appropriately in a time-critical situation. This can result in pilots attempting manoeuvres that increase the risk of stalling and loss of control.

There is currently no specific training or guidance for pilots in regard to incomplete power loss after takeoff and there is anecdotal evidence that such training is not routinely provided to student pilots. Training to 'cognitively prime' pilots in how to best handle this difficult emergency could have significant safety benefit. Such a program could be simulator based, allowing pilots to be exposed to realistic scenarios in a safe environment.

While the high number of variables in any partial power loss event makes it a difficult competency to train and assess, the development of a standard procedure would make it easier for a pilot to perform appropriately in time-critical situations. It would also allow a pilot to self-brief for a partial power loss event before a takeoff, an important factor in being able to successfully deal with such events.

Operation of amateur-built aircraft

The investigation reviewed the operation of amateur-built aircraft in Australia, including those permitted to operate over densely populated areas. The investigation found that CASA or its delegate managed the risk of amateur-built aircraft operation to persons on the ground or water by imposing conditions on the experimental certificate.

While CASA or its delegate was required to issue an experimental certificate, they must not allow the aircraft to fly over densely populated areas unless they are satisfied that the aircraft poses an acceptable risk to people on the ground or water. An aircraft that meets this requirement is typically of proven design, fitted with a certified engine/propeller combination and constructed of aircraft grade materials.

The investigation considered that the builder of an aircraft operated with an experimental certificate was likely to be aware of the risks associated with the operation of amateur-built aircraft. Although there was a placard in experimental aircraft giving a general warning of the risks, there was a lack of assurance that subsequent owners would understand the unique risk management aspects of the experimental operating environment.

Despite a relatively high indicative accident rate for amateur-built aircraft in the 1995 to 2005 period, the accident rate appears to be trending down.

FINDINGS

Contributing safety factors

1. During the initial climb after takeoff, the aircraft's engine lost power then operated intermittently until about the time the aircraft entered a steep descent.
2. The engine power loss and intermittent operation probably resulted from interruptions to the flow of fuel to the engine.
3. The pilot made an early steep right turn at 100 to 500 ft shortly followed by another steep right turn, also at a similar low level.
4. The aircraft stalled (aerodynamically) and entered a steep descent to the right before impacting the ground in a near level attitude.
5. Stall recovery in a Lancair 360 aircraft generally involves a significantly greater height loss than lower performance general aviation aircraft types.

Other safety factors

6. The aircraft was not fitted with a device to alert the pilot of the proximity of the aircraft's angle of attack to the stall.
7. Aircraft operating in accordance with an experimental certificate that includes permission to operate over densely populated areas are not required to be fitted with stall warning devices.
8. The *Day VFR Syllabus – Aeroplanes* and *Flight Instructors Manual* did not specifically address the management of incomplete engine power loss events in single engine aircraft that occur during, or soon after, takeoff.
9. There was a lack of formal guidance regarding how a pilot can comply with the CAO 40.1.0 subsection 4.4 (a) requirements to be familiar with the normal and emergency flight manoeuvres and aircraft performance of the aeroplane to be flown.
10. There was a lack of assurance that purchasers of amateur-built aircraft were aware of the unique risk management aspects of the 'experimental' operating environment.

Other key findings

11. The aircraft was an amateur-built Lancair 360 operated in accordance with an experimental certificate.
12. When issuing an amateur built aircraft with an experimental certificate, the Civil Aviation Safety Authority or delegate imposes limitations to manage the risk that operation of such an aircraft might pose to other airspace users and persons on the ground or water, especially in densely populated areas.

SAFETY ACTIONS

Civil Aviation Safety Authority

As a result of the two recent fatal accidents involving amateur-built experimental Lancair aeroplanes, the Chief Operating Officer (COO) requested a review of Lancair operations be undertaken. A review panel comprising a number of Civil Aviation Safety Authority (CASA) staff and an industry representative was formed. The review panel produced a report and made the following three recommendations to the CASA COO:

- That an article be published in Flight Safety Australia
- That guidance material for transition and recurrent training be developed for flight crew of high performance experimental aircraft
- That guidance material on risk assessment and mitigation be developed for authorised persons to ensure third party risks are appropriately considered when issuing an experimental certificate.

At the time of writing the report CASA advised that the following safety action had been undertaken in response to the Lancair review panel recommendations:

- An article 'Slick Singles' about new generation aircraft was published in the November-December 2006 edition of the Flight Safety Australia magazine.
- CASA's view is that a Civil Aviation Advisory Publication for Civil Aviation Order 40.1.0 section 4.4 may not be required. However, the development of some guidance material may be worthwhile and the Australian Transport Safety Bureau (ATSB) was invited to provide input to the next Flight Training Industry Development Panel meeting.
- Guidance material on risk assessment and mitigation in regard to the issuing of experimental certificates had been developed and was being progressively delivered to authorised persons.

The ATSB presented the safety issues identified by the investigation to CASA. At the time of writing the report CASA advised the following:

- The CASA Flight Instructor Manual – Aeroplane, was revised and re-issued in December 2006 with increased emphasis on engine failure on take off considerations and in particular aeroplane control, partial power loss and turn back.
- CASA is considering developing an Evening Safety Seminar presentation on engine failure after take off and emergency procedures. Once developed, this would be delivered to pilot groups by CASA Field Safety Advisors on request.
- A change to the *Day VFR Syllabus – Aeroplanes* was feasible, but would involve considerable work by CASA to not only change the syllabus but promote it to industry.
- CASA has written to authorised persons advising them to consider the fitment of stall warning devices.

Sport Aircraft Association of Australia

The ATSB presented the relevant safety issues identified by the investigation to the Sport Aircraft Association of Australia (SAAA) and understand that the following actions are planned:

- Review of the guidance given to authorised persons affiliated with the SAAA in regard to stall warning characteristics and other airworthiness features when applying operating limitations
- Cooperating with the insurance industry to form a ‘Lancair breed group’ and produce an aircraft familiarisation syllabus for high performance aircraft.

Australian Transport Safety Bureau

The ATSB has initiated a special investigation (ATSB investigation number 200603722) as a result of this and other occurrences, including the Cherokee Six accident at Hamilton Island on 26 September 2002 (ATSB investigation number 200204328). The bureau will investigate the factors that affect loss of control following engine power loss (including partial power loss) after takeoff.

APPENDIX A: LANCAIR FATAL ACCIDENT TABLE

Occurrence No	Aircraft	Location	Basic details
199304015	Lancair 235	Coffs Harbour, NSW	The aircraft was observed to approach the airfield at low level before abruptly entering a very steep climb. At an altitude estimated by witnesses as between 200 and 400 ft above ground level, the aircraft rolled right before diving vertically towards the ground and disappearing behind trees. A short time later, the sound of impact was heard and smoke was seen rising above the trees. The investigation concluded that, following the pull-up from about tree height, the aircraft probably stalled and entered an incipient spin to the right. The pilot and passenger were fatally injured.
199800740	Lancair 320	Bundaberg, Qld	The aircraft was enroute from Rockhampton to Archerfield when the pilot noticed that the engine had lost all oil pressure. The pilot transmitted a Mayday and advised intention to land on a road. That was the last recorded transmission from the pilot. The wreckage was found 380 m from the road. Examination of the accident site revealed that the aircraft impacted the ground at an angle of 45-50 degrees nose-down and banked approximately 90 degrees to the left. The pilot and passenger were fatally injured.
199901340	Lancair 235	Aldinga, SA	The aircraft departed Aldinga aerodrome and was 3 km to the north-east, when witnesses heard the engine surge and lose power. The aircraft was seen to enter a spin and crash into a dry creek bed. The reason for the aircraft entering a spin after the engine lost power could not be determined. The pilot and passenger were fatally injured.
200101082	Lancair 320	Nangiloc, Vic	The owner of the aircraft was demonstrating the aircraft to a prospective purchaser. A witness observed the aircraft descending in a spin and heard the aircraft impact the ground. The aircraft impacted the ground at high speed, with wings level and a steep nose-down angle. The circumstances of the accident were consistent with a loss of control during a demonstration of the handling characteristics of the aircraft at low speed with landing gear and flaps extended. The pilot and passenger were fatally injured.
200206005	Lancair IV-T	Drysdale, Vic	The pilot was test flying the aircraft that was fitted with a turbine engine. After a couple of stalls, the

			pilot initiated a stall at about 6,000 ft. The aircraft rolled and continued to roll as it descended rapidly at an angle of approximately 40 degrees from the horizontal. The aircraft impacted the ground upright, with the wings level, at a pitch angle of 40 degrees nose down. The pilot and other occupant were fatally injured.
200601640	Lancair 320	Archerfield, Qld	Preliminary information: The aircraft was inbound to Archerfield in marginal weather conditions. Witnesses observed the aircraft drop a wing and descend steeply. The aircraft impacted the ground in a steep nose-low, near vertical pitch attitude. The pilot was fatally injured. At the time of writing this report the investigation was continuing.
200301688	Lancair 360	Bankstown	See foregoing report.