Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Lancair Legacy, VH-ICZ

Shepparton Airport | 25 October 2013

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2013-193
Final – 1 December 2014

Cover photo: Global Composite Solutions

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

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

© Commonwealth of Australia 2014

Ownership of intellectual property rights in this publication
Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is owned by the Commonwealth of Australia.

Creative Commons licence
With the exception of the Coat of Arms, ATSB logo, and photos and graphics in which a third party holds copyright, this publication is licensed under a Creative Commons Attribution 3.0 Australia licence.

Creative Commons Attribution 3.0 Australia Licence is a standard form license agreement that allows you to copy, distribute, transmit and adapt this publication provided that you attribute the work.

The ATSB's preference is that you attribute this publication (and any material sourced from it) using the following wording: *Source:* Australian Transport Safety Bureau

Copyright in material obtained from other agencies, private individuals or organisations, belongs to those agencies, individuals or organisations. Where you want to use their material you will need to contact them directly.

Addendum

Page	Change	Date

Safety summary

What happened

At about 1415 Eastern Daylight Time on 25 October 2013, an amateur-built Lancair Legacy aircraft, registered VH-ICZ, with the pilot and one passenger on-board, took off from Shepparton Airport, Victoria, for a flight to Yarrawonga, Victoria. Witnesses reported that the take-off and initial climb appeared normal, however shortly after, the aircraft's pitch angle increased, after which it entered a descending right turn. The turn and descent continued until the aircraft collided with terrain alongside the airport boundary, fatally injuring the occupants and destroying the aircraft.

VH-ICZ accident site

Source: ATSB

What the ATSB found

The ATSB found that shortly after take-off, and for reasons which could not be determined, the aircraft entered a steep climb, likely entered an aerodynamic stall, and began a descending right turn that continued until the aircraft collided with terrain.

The ATSB's investigation was limited by the degree of damage to the aircraft and the presence of burnt carbon fibre. However, there was no evidence of any pre-existing mechanical fault with the aircraft and engine that could have contributed to the accident. A number of other possible contributing factors were considered and could not be completely discounted; those included sudden pilot incapacitation, aircraft handling, or the aircraft's weight and balance being outside the design limits.

The aerodynamic characteristics of the aircraft design were such that it could enter a partial or completely stalled condition with little warning. The aircraft was not required to be (and was not) fitted with an angle-of-attack indicator or stall warning device.

The ATSB's investigation found a number of instances where the regulatory requirements relating to the maintenance and operation of the aircraft had not been appropriately complied with. While the ATSB found no evidence that those non-conformances had brought about, or directly contributed to the accident, they did individually and collectively increase the risks associated with the aircraft's operation.

Safety messages

Although amateur-built aircraft operated in the *Experimental* category are not required to be fitted with a stall warning device, owner-pilots should consider the benefits of such devices as a further defence against the inadvertent approach to, or entry into an aerodynamic stall.

While amateur-built experimental aircraft are not required to comply with the full range of safety regulations that are applicable to commercially-manufactured aircraft, the regulations that do apply are fundamentally important and have been introduced to control and reduce (as much as possible) the risks associated with the operation of this category of aircraft.

The ATSB research report AR-2007-043(2) makes numerous conclusions on the higher accident and fatality rates associated with amateur built aircraft operations. Pilots and passengers need to remain cognisant of the increased risks when flying in this category of aircraft.

Contents

The occurrence

At about 1415 Eastern Daylight Time (EDT[1]) on 25 October 2013, an amateur-built Lancair Legacy retractable gear (RG) aircraft, registered VH-ICZ (ICZ), with the pilot and one passenger on-board, took off from runway 18 at Shepparton Airport, Victoria, for a private flight to Yarrawonga, Victoria.

The pilot (of ICZ) was witnessed preparing the aircraft for flight, which included 'clipping in' the canopy and completing run-up checks[2]. The aircraft was then taxied to the holding point for runway 18[3], waited for another aircraft to land, and then took off. The take-off and initial climb appeared normal to witnesses; however, shortly after the initial climb, the aircraft's pitch angle increased, followed by a descending right turn which continued until the aircraft collided with terrain (Figure 1). The aircraft was destroyed by impact forces and a fuel-fed fire. The pilot and passenger were fatally injured.

Figure 1: VH-ICZ accident site

Source: Google earth

1 Eastern Daylight Time (EDT) was Coordinated Universal Time (UTC) +11 hours.

2 Generally, a high power run-up check is carried out in a piston-engine aircraft to check the aircraft's ignition and other systems before commencing an initial take-off.

3 Runways are named by a number representing the magnetic heading of the runway. Runway 18 is on a magnetic heading of about 180 degrees.

Context

Aircraft information

The *Lancair Legacy RG* aircraft was a kit-built, high-performance low-wing aircraft with a composite airframe structure and retractable landing gear. The aircraft had a two-seat, side by side seating configuration, with pilot controls at each seat. It was powered by a Continental IO550-N, six-cylinder, piston engine, driving a constant-speed propeller. The engine was rated to 310 hp at 2,700 RPM.

The *Lancair Legacy RG* had a laminar flow wing design which was reported to have little warning of an impending stall. The aircraft was not fitted with a stall warning device or angle of attack (AoA) indicator, nor was it required to be. The manufacturer did however, have stall warning devices available for purchase. During a test flight conducted in 2012, it was noted that the aircraft typically lost around 300 ft during recovery from a stalled condition.

Construction and early maintenance

Despite several attempts during the investigation, the ATSB was unable to locate any of the aircraft's maintenance log books. It remains possible that this documentation was on-board the aircraft at the time of the accident (and subsequently destroyed).

In the absence of this important information, Civil Aviation Safety Authority (CASA) file documentation and commercial records from several maintenance organisations and the kit manufacturer were used to develop a history for the aircraft across its lifespan.

Initial construction of aircraft serial number L2K-305 (Figure 2) began in the United States in 2007 under the Lancair builder-assist program[4], it was then transported to South Africa and its construction completed by the original owner. It was first registered in South Africa as ZU-FCY on 16 January 2009.

In 2010, the aircraft was involved in a forced-landing accident resulting from engine problems. The aircraft sustained significant damage to the landing gear, propeller and airframe. The aircraft wreckage was subsequently purchased and repaired by a South African aeronautical manufacturing company, at which time the engine was rebuilt and fitted with a McCauley 3A32C418 3-blade propeller. That particular propeller was rated to a maximum of 280 hp at 2,500 RPM. This was not the standard combination recommended by the kit manufacturer for this aircraft. Test flights of the rebuilt aircraft were conducted during May 2012; after which it was sold, disassembled and imported into Australia during July 2012.

[4] The Lancair builder assist program assisted participants in developing the skills required to construct the experimental aircraft kit. A small amount of the aircraft is also constructed at the Lancair factory during the assist program.

Figure 2: VH-ICZ after being repaired in South Africa

Source: Global Composite Solutions

Assembly and maintenance in Australia

As the aircraft had not been built by the pilot who had purchased and imported it into Australia, the aircraft was required[5] to be re-assembled and maintained by a Licenced Aircraft Maintenance Engineer (LAME) or the holder of an appropriately endorsed maintenance authority. Contrary to this requirement, the ATSB found that the pilot had himself privately re-assembled the aircraft, and did not hold the appropriate maintenance endorsements for doing so. The ATSB was unable to determine if the re-assembly of the aircraft had been certified.

Registration

An initial application for transfer of the aircraft onto the Australian register was rejected by CASA, as it had not received confirmation from the South African Civil Aviation Authority (SACAA) that the aircraft was removed from their register. Subsequently, a letter was sent on 17 August 2012 to the SACAA from a person identifying themselves as an inspector for the Sports Aircraft Association of Australia (SAAA), stating that they had 'reviewed the maintenance documentation and logs and completed the inspection of the aircraft', and were 'satisfied that the aircraft is in good condition and will be accepted for inclusion on the Australian aircraft register in the experimental category.' The ATSB was unable to contact the individual whose details were supplied in that letter. The ATSB contacted the SAAA and requested contact details of the inspector: however, the SAAA informed the ATSB that the individual was not known to the SAAA and had no approval or membership with the organisation.

The aircraft received its Australian certificate of registration (as VH-ICZ) on 21 September 2012. At the time of registration, the aircraft had accumulated about 72 flight hours total time in service.

Airworthiness

Before operation in Australia, the owner of VH-ICZ (ICZ) was required to obtain a special certificate of airworthiness (SCoA), to allow the aircraft to be flown for testing and evaluation purposes, before the aircraft could be issued with a full certificate of airworthiness. When issued, the SCoA is intended to confirm that the aircraft:

- can reasonably be expected to be safe when it is operated under the conditions limiting its use; and
- is in a good state of preservation and repair; and
- is in condition for safe operation.

[5] Under Civil Aviation Regulations (CAR) 42ZC

When examined as part of the ATSB's aircraft documentation review, the checklist completed as part of the SCoA application process did not list any previous accidents or incidents in the aircraft history, and no major repairs were noted. Similarly, while the aircraft's maximum take-off weight (MTOW) had been increased as a part of the repair process in South Africa, that increase was not noted on the checklist.

The SCoA for ICZ was issued on 2 October 2012 and expired on 2 October 2013; 23 days prior to the accident. The ATSB could not locate any airworthiness certification for the aircraft that was valid at the time of the accident.

Before flight, the aircraft was required to have a valid maintenance release completed and retained in the aircraft. The maintenance release was not found at the accident site, but may have been destroyed in the fire. ATSB inquiries of the maintenance organisation nominated on the SCoA application stated that they had not issued any maintenance releases for the aircraft.

Performance charts

The kit manufacturer's Pilot Operating Handbook (POH) was recovered from the aircraft wreckage. As part of the aircraft's initial flight testing and airworthiness evaluation process permitted under the SCoA, the POH required the completion of several performance charts, including a stall speeds chart for various aircraft configurations. A pilot's knowledge of an aircraft's stalling speeds is highly important for safe operation during all phases of flight – particularly the lower speed operations such as take-off and landing. The POH is generally the reference to which pilots will refer when first operating or seeking endorsement on an aircraft.

None of the required performance charts had been completed within the POH recovered from the accident site. It was not known or able to be established whether the POH recovered was the original handbook as issued for the aircraft, or whether a new POH was obtained when the aircraft was imported into Australia.

Carriage of passengers

One of the limitations applicable to ICZ being operated under its SCoA was that a 'Passenger may be carried for data logging, provided they are advised of the experimental nature of this aircraft prior to boarding.' Data logging in this context refers to the gathering of information during the conduct of flight testing, as detailed in a defined flight test schedule. The ATSB did not find any evidence that the passenger on the accident flight was on-board for, or tasked with data logging duties, nor was it evident that the flight was undertaken for flight testing purposes.

Weight and balance

The centre of gravity (CG) of an aircraft indicates the balance or distribution of weight throughout the aircraft. It can be affected by the amount of fuel on board, the landing gear position, occupants' weight and any baggage being carried. The balance or distribution of weight within an aircraft affects the stability and controllability of an aircraft. Any fuel added to ICZ would have resulted in a rearwards movement of the CG. The approved Lancair Legacy CG position limits extended from 10 percent to 25 percent of the wing mean aerodynamic chord. The POH stated that an 'aft CG will in general worsen stall behaviour and aircraft stability'.

The Lancair Legacy original design had a designed maximum take-off weight (MTOW) of 998 kg and a maximum zero fuel weight (MZFW)[6] of 862 kg. As part of the repair process in South Africa, a static load test was performed and approved by the SACAA. The weight and balance data recorded after the repairs, as well as the data submitted as part of the SCoA process in Australia, showed an increase in the aircraft's MTOW to 1,089 kg; i.e. 91 kg above the kit manufacturer's defined limit. However, as there was no corresponding documentation that allowed a

[6] The maximum zero-fuel-weight of an aircraft is a limit, imposed by the designer to which an aircraft may be loaded, not including fuel. Any weight above this figure can only be in the form of fuel.

corresponding increase in the MZFW, and the repairs to the aircraft had increased the empty weight to 741 kg, the effective useful load (not including fuel) was thus reduced to 121 kg (before the MZFW limit was reached). While the aircraft underwent flight testing at a weight of 998 kg, the ATSB did not find any record of flight performance testing carried out at the increased MTOW.

As the aircraft (after the repairs and MTOW increase) only had a useful load of 121 kg before the addition of fuel, any loading would have to have been carefully managed. In practical terms, it was a single person aircraft, with a pilot of 95 kg allowing only an additional 26 kg of weight to be added before reaching the MZFW limit. It was not possible to have two adult persons of average weight on board the aircraft without exceeding the MZFW limit.

The build process of each individual Lancair Legacy affected the weight and balance of the aircraft such that the relevant sections of the POH were required to be completed by the builder or pilot. The weight and balance record in the POH recovered from the wreckage of ICZ did not appear to have been endorsed by an authorised weight and balance authority.

The ATSB was unable to determine the amount of fuel that had been on-board the aircraft at the time of the accident. The fuel provider at Shepparton Airport advised that they had not uploaded fuel to the aircraft for a significant amount of time. Fuel delivery records associated with a gravity fed fuel bowser located at the hangar where the aircraft was kept, could not be located.

Pilot information

While the pilot's personal flying logbook/s were unable to be located, his licence and medical records were obtained from the Civil Aviation Safety Authority (CASA) – providing a useful summary of experience and qualifications held.

The pilot commenced flying training in 1989, and later that year gained a Private Pilot Licence (PPL) (Aeroplane). He attained a constant speed propeller and retractable undercarriage endorsement in 1991. In accordance with Civil Aviation Regulation (CAR) 5.04, to exercise the privileges of the PPL, the pilot was also required to hold a valid Class 2 Aviation Medical Certificate. According to CASA records, the pilot's most recent Class 2 aviation medical certificate had expired on 27 April 2012.

The pilot's most recent medical certificate application (27 April 2010) listed 1,260 hours of flying experience, with no flying recorded during the previous 6 months. Previous medical certificate records, issued on 27 August 2002, recorded 1,068 total flying hours and 40 flying hours in the previous 6 months. That certificate was valid until 27 August 2004.

The unavailability of the pilot's logbooks meant that the ATSB was unable to determine the pilot's aeronautical experience in Lancair Legacy RG aircraft. Information made available to the ATSB indicated that during the purchase of ICZ, the pilot had travelled to South Africa and completed some flight training in the aircraft, however the nature and extent of that training was unknown.

The ATSB was unable to verify if the pilot had met the currency requirements of three take-offs and landings within the previous 90 days - as required by regulations for the carriage of passengers. However, the pilot was reported to have flown a return flight from Shepparton Airport to a private airstrip in the week prior to the accident flight, and the owner of the airstrip also recalled the pilot of ICZ flying on another occasion in the previous month. It was also unknown whether the pilot had undertaken a biennial flight review within the preceding 2 years. The biennial flight review ensures the maintenance of critical skills and is required for pilots wishing to maintain the validity of their licences.

Relatives reported the pilot as well rested prior to the flight, with no recent medical or personal issues. Post-mortem examination and toxicological testing revealed the presence of prescription medication within the pilot's system; the side-effects of which had the potential to impair concentration and attention. A review of the pilot's last medical certification (2010) showed no records indicating that medication was being taken at that time. While it is not known when the pilot began taking the medication that was detected in his system, it is a regulatory requirement

that all pilots disclose to CASA and/or a designated aviation medical examiner (DAME) when they commence taking over-the-counter or prescription medication in response to a medical condition. Such disclosure is also required when undergoing a general medical examination as part of a routine medical certificate renewal or re-issue process. The DAME and/or CASA would then assess the medical condition and the medication for potential influences that may affect the pilot's ability to safely exercise the privileges of their licence.

Meteorological information

The weather forecast current for Shepparton Airport at the time of the accident was for westerly winds up to 12 kt, visibility greater than 10 km and scattered[7] cloud at 4,500 ft. Recorded observations and witness reports of the weather at the time of the accident were consistent with the forecast.

The position of the sun at the time of the accident was determined from the Geoscience Australia website[8]; showing the sun to have been at a 322 °T (north-west) azimuth (from true north), and approximately 61° above the horizon. The direction of departure (approximately 179 ºT) meant that there was little potential for direct glare from the sun to have affected the pilot's visibility (as the sun would have been over the pilot's right shoulder).

Airport information

Shepparton Airport was situated about 5 km south of Shepparton town centre on the Goulburn Valley Highway. It had two runways, a 1,378 m tarmac runway 18/36, and a 423 m gravel runway 09/27.

Witness information

A witness standing outside a hangar adjacent to where ICZ was kept reported seeing the pilot of ICZ preparing the aircraft for flight. The witness observed the pilot close the canopy and 'clip it', prior to starting the aircraft. After about 3 minutes, the witness observed the aircraft taxi to the holding point for runway 18, conduct run-up checks, and wait several minutes for an arriving aircraft to land.

Two witnesses stated that the take-off and initial climb appeared normal. Shortly after, the aircraft's pitch angle increased, followed by a descending right turn that continued until the aircraft collided with terrain alongside the airport boundary fence. One witness reported that the undercarriage appeared to be extended for a long period of time.

Wreckage and impact information

The ATSB's initial examination of the wreckage found that the aircraft had struck the airport boundary fence in a right wing low attitude. The ground impact marks and aircraft damage were consistent with a right wing impact, followed shortly after by the propeller and engine.

The empennage, engine and left wing had separated from the main fuselage during the impact sequence. The aircraft came to rest in an embankment on a road, about 40 m west of the airport boundary fence.

Both wing fuel tanks had ruptured and an intense, post-impact fuel-fed fire had destroyed much of the aircraft's composite structure. Despite this, all of the major aircraft components were identified at the accident site, and no evidence of pre-impact damage was apparent. Similarly, there was no

---

[7] Cloud cover is normally reported using expressions that denote the extent of the cover. Scattered indicates that cloud was covering between a quarter and a half of the sky.

[8] www.ga.gov.au

evidence of bird strike damage: however, the extent of destruction sustained by the aircraft precluded a comprehensive assessment.

Elevator trim settings were found set at about the neutral position. The flap setting was unable to be determined due to the disruption during the accident sequence. Propeller rotational damage and ground strike marks were consistent with the engine operating at high power at the time of ground contact. The gear selector was found in the down position; however the landing gear was determined to be in the retracted position at impact.

The aircraft canopy had separated from the main fuselage structure during the accident sequence. While the ATSB's examinations were unable to directly determine the position of the canopy latch, there were no witness reports of the canopy opening during the flight.

Survival aspects

From the level of disruption sustained by the aircraft, and the corresponding reduction in survivable space within the cockpit and cabin areas, the accident was not considered to have been survivable.

Regulatory information

Under the Australian Civil Aviation Regulations, the *Experimental* designation formed part of the broader *amateur-built* category of aircraft. Such amateur-built experimental aircraft were not required to comply with the safety regulations for commercially-manufactured aircraft, and as such, were required to display the following placard in the cockpit in full view of all occupants:

WARNING

THIS AIRCRAFT IS NOT REQUIRED TO COMPLY WITH THE

SAFETY REGULATIONS FOR STANDARD AIRCRAFT.

YOU FLY IN THIS AIRCRAFT AT YOUR OWN RISK.

Due to the extent of the post-impact fire, it was not possible for the ATSB to visually identify the placard. However, photographs of aircraft indicated that the placard was in a visible location on the canopy. Additionally, several previous passengers recalled seeing the placard and noted its location on the canopy.

Required flight testing

Phase 1 of the SCoA for ICZ had been issued in accordance with the SAAA's *Authorised Person Manual of Procedures, Special Certificate of Airworthiness – Experimental* (SAAA manual). The SAAA manual noted that the Phase 1 of the SCoA is typically issued for the purpose of establishing the performance characteristics of an aircraft during a defined regime of flight testing.

Both the SAAA manual and the CASA advisory circular AC 21.4 (Amateur-built experimental aircraft – certification) referred to United States Federal Aviation Administration Advisory Circular AC 90-89A, *Amateur-Built Aircraft Flight Testing Handbook (AC 90-89A)*, and encouraged its reference prior to flight test programs commencing. The goals of AC 90-89A were to ensure, after successful completion of the aircraft's flight test phase, the aircraft would be adequately tested, airworthy and safe to operate within its established operational envelope. It also provided guidance for the incorporation of the flight test operational and performance data into the aircraft's flight manual, so the pilot can reference the data prior to each flight. Many of the flight tests in AC 90-89A were for the purpose of familiarising the pilot with the aircraft handling qualities.

AC 90-89 outlined the order in which flight testing should be carried out and provided guidance on how the flight testing should be conducted. It recommended that stall testing be carried out through flight test hours 11-20 and accelerated stall testing throughout flight test hours 21-35.

The SAAA manual also noted that the following general operating conditions and limitations should be prescribed (as a minimum) for Phase 1 flight testing:

- This Certificate for Phase 1 flight testing expires on (insert data 12 months ahead). The applicant is to advise the Authorised Person (AP) if an extension is required. An AP may consider slightly longer periods if circumstances dictate.
- No passengers may be carried under any circumstance, i.e. Pilot in Command only. Or; if a second crew member is required for some flights and specifically detailed within the applicant's flight test schedule.
- Flight crew considered essential for a particular test flight may be carried. The second crew member may only be carried after sufficient basic stability and controllability parameters of the aircraft have been established.

Related occurrences

A search of both the ATSB and US National Transportation Safety Board (NTSB) databases found several loss-of-control events for the Legacy RG and Legacy fixed landing gear aircraft types; however, none of the circumstances surrounding these events were similar to that of ICZ.

Research

ATSB research report AR-2007-043(2), published 26 March 2013 made the following conclusions in relation to amateur built aircraft:

- Between 1988 and 2010, amateur-built aircraft on the Australian VH-register had an accident rate three times higher than comparable VH-registered factory-built aircraft conducting similar flight operations.
- The fatal and serious injury accident rate was more than five-times higher in amateur-built aircraft than similar factory-built aircraft.
- Loss of aircraft control led to 25 percent of all amateur-built accidents; slightly more than for factory-built aircraft accidents, however, the loss of control accident *rate* was over four times higher. Against factory built aircraft, serious injury was three times more likely after loss of control in amateur-built aircraft accidents. In respect of amateur-built aircraft, loss of control accidents were more likely to arise from aircraft handling issues where pilots had comparatively lower levels of experience on the aircraft type. Similarly, loss of control was more likely to occur in the initial climb phase of flight.

Safety analysis

Introduction

During the early phase of flight following take-off, the pilot appeared to lose control of the aircraft and was unable to recover before impacting the ground. Following the pitch-up event, the dynamics described by witnesses were consistent with the aircraft entering an asymmetric aerodynamic stall, whereby lift is lost unevenly from the wings, producing an uncommanded roll (in this instance to the right). The ATSB analysis focussed on the potential factors that may have contributed to the pitch-up event and loss of control.

Potential reasons for the pitch up

Medical incapacitation

While the possibility of the pilot experiencing an incapacitating medical event during the flight could not be excluded, it was considered unlikely and was not supported by any definitive evidence. Although the pilot did not hold a current medical certificate, he was not reported to have been experiencing any recent acute medical issues, and the post-mortem examination did not identify any other conditions that may have affected the pilot's ability to control the aircraft.

The pilot's family indicated that in the days immediately preceding the accident, he had been in a good mood and was well rested. The prescription medication being taken to manage a chronic medical condition did have the potential to affect the pilot's ability to safely operate the aircraft: however, there was no evidence that the pilot was experiencing (or had experienced) any adverse effects from that medication at any time leading up to the accident.

The aircraft passenger did not have any known or detected medical conditions that may have become manifest during the flight – having the potential to cause interference with the aircraft flight controls or to act as a strong distraction to the pilot.

Mechanical issues

To the extent it was possible to determine, given the extent of damage and destruction sustained during the accident, there was no evidence that any mechanical failure or unserviceability of the aircraft components or structures had contributed to the development of the accident.

Similarly, there was no evidence to indicate that damage from the previous accident, or the repair processes and procedures applied, had contributed to the accident.

Witnesses that reported hearing the aircraft did not note any sudden or dramatic change to the engine note that might have characterised a partial or complete loss of power. Damage to the aircraft's propeller was consistent with the engine delivering a significant level of power at the time of impact.

Weight and balance

As stated by the kit manufacturer in the pilot operating handbook (POH), a centre of gravity (CG) towards the aft limit would, in general, worsen stall behaviour and aircraft stability, resulting in the aircraft becoming increasingly difficult to handle. The ATSB was unable to determine the amount of fuel on-board the aircraft at the time of the accident, and was therefore unable to accurately determine the weight and balance (and/or CG) of the aircraft. However, it was known that the aircraft's maximum zero fuel weight (MZFW) listed in the POH, had been exceeded by about 63 kg, and the addition of any fuel would result in a rearwards movement of the CG. Within the scope of the investigation, it was unclear what effect the increase in take-off weight may have had on the handling and performance of the aircraft during the accident flight. However, it was determined that the aircraft was unable to carry the pilot, passenger, luggage and full fuel without the CG moving beyond the manufacturer's defined aft CG limit.

Handling and avoidance

The aircraft had been registered to the pilot for approximately 12 months, but the inability to examine either the pilot's or aircraft's logbooks meant that the pilot's total experience flying this type of aircraft was unknown. Similarly, the ATSB was unable to determine the amount of training that had been completed by the pilot in Lancair Legacy RG aircraft. Training, experience and currency with the performance and behavioural characteristics of an aircraft type provides pilots with a greater ability to respond appropriately to unusual or emergency situations, or avoid entering flight regimes that may lead to loss of control.

The pitch up manoeuvre, as a possible action to avoid a bird or flock of birds was considered, and again, while not discountable, was not supported by any witness observations or known aerodrome bird hazards present at or around the time of the accident.

Recovery from a stall

During the on-site examination, the ATSB was unable to determine whether the aircraft was fitted with a stall warning device; furthermore, the kit manufacturer indicated that the basic Legacy kit did not include a stall warning device. Certified aircraft are required to have a stall warning furnished either through inherent aerodynamic qualities of the aeroplane or by a device that will give clearly distinguishable indications under the expected conditions of flight[9]. However, ICZ was not required to have a stall warning device as it was an amateur built aircraft. In the absence of a stall warning device or angle-of-attack indicator, the Lancair Legacy RG was reported to provide little advanced warning of any impending aerodynamic stall. The Lancair Legacy RG was a high performance, experimental amateur built aircraft. The stall characteristics for each individual aircraft of an amateur built type depend to an extent on the precision of the aircraft build, necessitating the need for the pilot to complete stall testing for the aircraft and recording the results in the POH. The pilot's possible lack of familiarity with the stall behaviour of the aircraft (evidenced by the incomplete stall performance charts in the POH) would also reduce the pilot's awareness of the speeds and conditions at which a stall may be encountered. Notably, as stated in the POH, an 'aft CG will in general worsen stall behaviour and aircraft stability.'

A flight test report completed after the aircraft was repaired in South Africa indicated that the aircraft typically lost 300 ft of altitude during a stall recovery. In the context of this accident, where a witness estimated the stall and possible loss of control had occurred at about 50 ft, it would have been very difficult for the pilot to successfully recover the aircraft before colliding with the ground. The POH did not contain any completed performance information which the pilot could have referenced prior to the accident flight.

The Federal Aviation Administration of the Unites States of America issued *InFo*[10] 14010 on 14 July 2014 recommending the installation and use of angle-of-attack (AoA) based systems to reduce the risk of inadvertent stall that may result in a loss of control accident.

Aircraft documentation and regulatory aspects

Aircraft maintenance and pilot log books record important information on the history of both the pilot and aircraft. It is important that they be kept up to date and in a safe location. In this instance, the ATSB's inability to locate or examine these documents significantly limited the conclusions that could be drawn from the accident investigation.

---

[9] Federal Aviation Regulation (FAR) 23.207(b)

[10] An InFo (Information for Operators) contains valuable information for operators, InFo 14010 is available at: http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info/all_infos/media/2014/InFO14010.pdf

Australian aviation regulations exist to ensure the safe conduct of flight for the benefit of passengers and the general public. Medical certificates and special certificates of airworthiness (SCoA) have defined expiry dates, to ensure that both pilots and aircraft are regularly assessed for fitness and airworthiness. In this instance, given the lack of currency of the pilot's medical certificate and the aircraft's SCoA, the level of independent assurance that airworthiness or medical issues would not affect flight safety was reduced.

The aircraft's SCoA was issued as evidence that the aircraft had been assessed and found safe for operation by a CASA authorised person. It was unable to be determined if AC 90-89A was followed during that assessment - as recommended in CASA advisory circular AC 21.4. All the accident and repair history for the aircraft was required to be documented during the certification process. The forms submitted for VH-ICZ did not list the accident, repairs or modifications that were carried out in South Africa. The certification process should have identified the previous accident and a thorough review of the repairs should have been conducted.

Amateur-built experimental aircraft were not required to comply with the safety regulations for standard (certified) aircraft. The ATSB research report AR-2007-043(2) makes numerous conclusions on the higher accident and fatality rates associated with flying amateur built aircraft. The flight testing phase of experimental aircraft certification has inherent risks associated with determining the stability and controllability of the aircraft. Because of these risks, one of the conditions specified on the SCoA for ICZ was that a passenger was not permitted unless required for data logging purposes. The ATSB found no evidence that the passenger was on-board the aircraft for this reason.

Findings

From the evidence available, the following findings are made with respect to the loss of control of Lancair Legacy RG, registered VH-ICZ, Shepparton Airport, Victoria on 25 October 2013. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- For reasons that could not be determined from the evidence available, shortly after take-off, the aircraft entered a steep climb, likely stalled and began a descending right turn that continued until the aircraft collided with terrain.
- The carriage of a passenger, on a flight that was likely not for data logging purposes, was contrary to the conditions of the special certificate of airworthiness.

Other factors that increase risk

- The high-performance aircraft type exhibited little warning of an aerodynamic stall, and it was not fitted with a stall warning device.
- The application for the special certificate of airworthiness had several inconsistencies that were not identified during the issuing process.
- The zero fuel weight of the aircraft during the accident flight exceeded the maximum zero fuel weight specified by the kit manufacturer.
- Aircraft assembly was undertaken by the pilot, without the appropriate qualifications or the supervision of an authorised person.
- The pilot's most recent medical certificate had expired 18 months before the accident.
- The special certificate of airworthiness required to legally fly the aircraft, had expired 23 days before the accident.
- Provisions in the Pilot's Operating Handbook for the documentation of the aircraft's stall speed characteristics had not been completed, suggesting that the stall characteristics of the aircraft had not been properly evaluated after its registration in Australia.

General details

Occurrence details

Date and time:	25 October 2013 – 1415 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	Shepparton Airport	
	Latitude: 36° 25.768’ S	Longitude: 145° 23.369’ E

Aircraft Details

Manufacturer and model:	Lancair Legacy Retractable Gear	
Registration:	VH-ICZ	
Serial number:	L2K-305	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – 1 (Fatal)	Passengers – 1 (Fatal)
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Witnesses
- Aircraft repair organisation
- Civil Aviation Safety Authority (CASA)
- Victoria Police
- Victoria State Coroner
- Lancair International, Inc.

Submissions

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

A draft of this report was provided to The Civil Aviation Safety Authority (CASA), Victoria State Coroner, the United States National Transport Safety Board (NTSB), the aircraft repair organisation, the nominated aircraft maintenance organisation and the aircraft certification organisation.

A submission was received from the Civil Aviation Safety Authority. The submission was reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

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 identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, 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 initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

Enquiries 1800 020 616
Notifications 1800 011 034
REPCON 1800 011 034
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation

Collision with terrain involving Lancair Legacy, VH-ICZ
Shepparton Airport, 25 October 2013

AO-2013-193
Final – 1 December 2014