

AIRCRAFT ACCIDENT REPORT
OCCURRENCE NUMBER 08/2220
ZENITH CH601-XL
ZK-ZXL
WAIROA AERODROME
25 MAY 2008



FOREWORD

Aviation safety investigations are conducted in New Zealand pursuant to New Zealand's international obligations under the Convention on International Civil Aviation 1944 – also known as the Chicago Convention. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation (“ICAO”) has issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents. Paragraph 3.1 of Annex 13 describes the sole objective for the investigation of such accidents as follows:

3.1 The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

This philosophy of prevention for the future promotion of aviation safety is reflected in the New Zealand domestic law by virtue of the provisions of the Civil Aviation Act and Part 12 of the Civil Aviation Rules. CAA accident investigations operate under this philosophy.

CAA accident investigations are conducted in accordance with ICAO guidelines. The sole objective of such investigations is the prevention of accidents by determining the contributing factors or causes and then implementing appropriate preventive measures - in other words restoring safety margins to provide an acceptable level of risk.

CAA safety investigations are performed to establish the causes of the accident on the balance of probability. Accident investigations do not always identify one dominant or ‘proximate’ cause. Often, an aviation accident is the last event in a chain of several events or factors, each of which may contribute to a greater or lesser degree, to the final outcome.

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Abbreviations used in this report

AMSL	above mean sea level
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule(s)
DI	directional indicator
ELT	emergency locator transmitter
FAA	Federal Aviation Administration
ft	feet
HP	horsepower
km	kilometre(s)
m	metre(s)
NZST	New Zealand Standard Time
NZ	New Zealand
PAL	pilot activated lighting
RPM	revolutions per minute
TAIC	Transport Accident Investigation Commission
THC	Tetrahydrocannabinol
VFR	Visual Flight Rules

AIRCRAFT ACCIDENT REPORT

OCCURRENCE No 08/2220

Aircraft type, serial number and registration:	Zenith CH601XL, S/N 6-9726, ZK-ZXL
Number and type of engines:	One, Bombardier-Rotax GmbH 912ULS
Year of manufacture:	2005
Date and time:	25 May 2008, 0320 hours ¹ (approximately)
Location:	Wairoa Aerodrome Latitude ² : S 39° 00.0' Longitude: E 177° 24.0'
Type of flight:	Private
Persons on board:	Crew: 2
Injuries:	Crew: 2 fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	NZ Commercial Pilot Licence (Aeroplane)
Pilot-in-command's age:	30
Pilot-in-command's total flying experience:	560 flight hours
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr T.P. McCready

¹ Times are NZST.

² World Geodetic System (WGS 84) co-ordinates.

Synopsis

The Rescue Co-ordination Centre New Zealand was notified at 0440 hours on 25 May 2008 that an aircraft had departed from Wairoa Aerodrome at 0315 hours and had not returned as expected. The CAA and TAIC were notified at 0600 hours that a search was underway. The aircraft was located shortly after daylight. Both occupants were found in the aircraft wreckage fatally injured. The TAIC declined to investigate. A CAA field investigation was commenced that day.

1. Factual information

1.1 History of the flight

- 1.1.1 The two occupants of the aircraft and a third person had been attending a social function at a property about 20 minutes drive from the aerodrome. At approximately 0230 hours, after an evening of drinking at a party, the three people travelled to the Wairoa Aerodrome. There they gained access to a microlight inside a hangar belonging to the Wairoa Aero Club. They were able to gain entry because one of the three was the Chief Flying Instructor and another the President of the Aero Club.
- 1.1.2 At approximately 0315 hours the third person witnessed the aircraft taxiing to take-off to the north-west, in a direction away from the Wairoa town lights. The witness also stated that he saw the take-off roll along Runway 34, but did not see the aircraft leave the ground due to loss of sight from his position inside the hangar. However, he is sure that he saw the aircraft lights 30 seconds later, indicating that the aircraft was airborne turning to the south (towards the Wairoa township). The witness remained waiting in another microlight inside the hangar. When the aircraft did not return the witness at the aerodrome contacted the local police at 0430 hours.
- 1.1.3 A search was commenced at daylight and the wreckage was located at 0730 hours.
- 1.1.4 The accident occurred at night, at approximately 0320 hours NZST, adjacent to Wairoa Aerodrome, at an elevation of 60 feet AMSL. Latitude S 39° 00.0', Longitude E 177° 24.0'.

1.2 Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Other</i>
Fatal	2	0	0
Serious	0	0	0
Minor/None	0	0	

Table 1: Injuries incurred from the accident.

1.3 Damage to aircraft

- 1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Not applicable.

1.5 Personnel information

1.5.1 The Chief Flying Instructor was occupying the right seat of the aircraft. He held a Commercial Pilot Licence (Aeroplane) and an instrument rating. He had a current Class 1 medical certificate appropriate for that licence. He also held a C category instructor rating and microlight senior instructor rating. He had a recorded total time of 560 flight hours, including 12.2 hours night flying of which 7.9 hours were recorded as pilot-in-command.

1.5.2 The pilot occupying the left seat held a Private Pilot Licence (Aeroplane). He had previously held a Class 2 medical certificate appropriate for that licence. His medical certificate had expired on 4 February 2008. He had recorded 12.6 flight hours since his medical certificate had expired. He had a total time of 220 flight hours, but no recorded night flying experience.

1.6 Aircraft information

1.6.1 The aircraft was first registered in New Zealand after construction on 15 September 2005 and was retained and operated by the aircraft distributor as a demonstration aircraft.

1.6.2 The aircraft was then purchased and operated by the Aero Club from 2 November 2006 until the time of the accident.

1.6.3 The aircraft had an ongoing inherent problem with lateral trim. This required some degree of aileron trim to be maintained for the aircraft to be in a balanced condition for straight and level flight.

1.6.4 In the past one of the ailerons had received minor damage which, after the repairs, exacerbated the aircraft's out-of-trim condition.

1.6.5 In an attempt to fix the trim problem, the Club devised a modification which involved placing a balance spring in the aileron control system. This was only partially successful and was an unapproved modification. When this came to the attention of two CAA Field Safety Advisors, the Club was advised to remove the modification and instead replace the aileron skin with a factory supplied part.

1.6.6 The aircraft was grounded for two months while the repair work was undertaken on the ailerons. This work was completed four weeks prior to the accident flight.

1.6.7 Following this repair the aircraft was technically restored to an airworthy condition, but the original inherent out-of-trim condition still remained. This condition was in the end accepted by the Club and pilots flew the aircraft with the aileron trim set with the indicators (which consisted of five lights either side of neutral) showing two lights to the left.

1.7 Meteorological information

- 1.7.1 The weather conditions at the time of the accident flight were poor, with passing rain showers and strong gusty south-east winds. It was night time with poor visibility.
- 1.7.2 At the same time as the accident flight, an experienced rescue helicopter pilot was grounded at the Wairoa Hospital helicopter landing pad 3 km from the aerodrome due to the poor weather conditions and darkness. He was awake and on duty at the time of the accident assessing the weather conditions for a return flight to his base at Hastings.
- 1.7.3 Another witness located south of the aerodrome in the Wairoa township stated that he heard the aircraft engine noise approaching and turning back towards the aerodrome. He noted that heavy rain was falling at the time.
- 1.7.4 CAR 103.155 *Microlight Aircraft – Certification and Operating Rules*, Flight Criteria, states:
- (a) A pilot shall only operate a microlight aircraft—
 - (1) by day; and
 - (2) in VFR meteorological minima equal to or better than those prescribed in CAR 91.301.
- 1.7.5 CAR 91.301 *General Operating and Flight Rules* details the minimum visibility conditions that an aircraft may be operated in at aerodromes in uncontrolled airspace, such as at Wairoa Aerodrome is:

		Ceiling	Flight Visibility
All aircraft	Day	600 ft	1500 m
All aircraft	Night	1500 ft	8 km

Table 2: VFR meteorological minima.

1.8 Aids to navigation

- 1.8.1 Not applicable.

1.9 Communications

- 1.9.1 Not applicable.

1.10 Aerodrome information

- 1.10.1 Wairoa Aerodrome is an uncontrolled aerodrome in uncontrolled airspace.
- 1.10.2 The aerodrome has pilot activated lighting (PAL) on the sealed portion of the runway, which enables night operations to be conducted.

1.11 Flight recorders

- 1.11.1 The Hobbs meter, a mechanical recording device, was found undamaged with a reading of 0429.9 hours.

- 1.11.2 The last recorded meter reading from the previous flight was 0429.8 hours, which is a difference of 0.1 of an hour, or six minutes.
- 1.11.3 The Hobbs meter installation was activated by an air switch which records flight time in excess of about 40 knots of airspeed.

1.12 Wreckage and impact information

- 1.12.1 The aircraft was located 150 metres north-west of the extended centre line of Runway 34, in a heavily water-logged flat pasture paddock. The aircraft had impacted the ground from a near vertical attitude. The left wing had struck the ground first and the rear fuselage had fractured behind the cabin area causing the rear fuselage to come to rest inverted over the cabin.
- 1.12.2 The wreckage was contained within a small impact area, with the exception of the propeller and cabin Perspex which was scattered over a 15 metre area.



Figure 1: General distribution of wreckage.

Note – the rear fuselage has been moved to allow access to the aircraft cockpit area.

- 1.12.3 The flight control positions were noted as:
- Flaps:** 10 degrees down position as measured by the flap actuator stroke position.
- Elevator trim:** displaced 9 degrees down.
- Aileron trim tab:** displaced 12 degrees up.

The elevator trim and flap actuator extension indicate that the aircraft was configured for a landing approach.

- 1.12.4 Fuel spillage was mixed in with the waterlogged ground, as evidenced by a large number of worms being killed by fuel seepage into the ground.
- 1.12.5 The fuel selector was found positioned fore and aft midway between the 'LEFT' and 'RIGHT' tank selection positions.
- 1.12.6 A personal locator beacon was found in its pouch secured in the cabin. It had not been activated. No aircraft-mounted ELT was fitted, nor was it required to be under the provision of CAR 91.529(e)(2), *Emergency locator transmitter*.
- 1.12.7 The aircraft was recovered to a secure facility for more detailed inspection, during which the integrity of the flight controls was established. It was discovered that the two flaps had a slight asymmetry problem due to the rigging of the controls and stops.

1.13 Medical and pathological information

- 1.13.1 Post-mortem examination showed that both occupants died of injuries consistent with a high energy impact with the ground.
- 1.13.2 The instructor's and pilot's toxicology tests confirmed that both were heavily intoxicated with blood alcohol levels of 320 milligrams and 236 milligrams of alcohol per 100 millilitres of blood respectively. A police witness statement taken from the third person indicated each person had consumed around 20 cans of beer during the evening before the flight.
- 1.13.3 The pilot's toxicology test also revealed that THC (the main psychoactive ingredient of cannabis – indicating possible cannabis use) was evident and that cannabis had possibly been used one to ten hours prior to the flight.

1.14 Fire

- 1.14.1 Fire did not occur.

1.15 Survival aspects

- 1.15.1 The accident was not survivable due to impact forces involved.

1.16 Tests and research

- 1.16.1 The fuel selector was removed from the aircraft and tested because it had been found in the mid-travel position without any obvious interference. This position may have resulted in fuel starvation to the engine. The unit was flow tested and dismantled, confirming continued fuel flow in this position.
- 1.16.2 Practical testing was carried out on an identical fuel selector installed in an RV-6 aircraft. The mid-travel position was selected and the engine ran for at least one minute on the ground at full engine power with the auxiliary fuel pump off.

- 1.16.3 Flight testing with the fuel selector in mid-travel position was also carried out in an RV-6 aircraft with a Lycoming O-320D1A rated at 160HP at 2700 rpm. This involved two minutes at climb power with the auxiliary pump off. A normal fuel delivery of 55 litres per hour was attained, then 30 minutes in the cruise running between 36 litres per hour down to 28.5 litres per hour. Exhaust gas temperatures and cylinder head temperatures were recorded as normal.
- 1.16.4 Research in to the fuel selector revealed that although this model has a ‘LEFT’ and ‘RIGHT’ (tank) selection position, when it is installed in the Zenith 701XL aircraft, fuel can still flow to the engine when the selector is moved to a mid-travel position.



Figure 2: Fuel Selector at mid travel position

- 1.16.5 The flap actuator was removed from the airframe and tested to ensure electrical continuity and mechanical operation. Flap actuator extension comparisons were also made with another identical aircraft to relate the observed extension to a flap position.
- 1.16.6 A literature review on the effects of drinking and flying was carried out. In particular a paper by FAA Civil Aerospace Medical Institute Aeromedical Education Division was reviewed. Points noted in that paper, and relevant to this accident include:
- *The majority of adverse effects produced by alcohol relate to the brain, the eyes, and the inner ear, which are three crucial organs to a pilot while flying.*
 - *Brain effects include impaired reaction time, reasoning, judgment, and memory. Alcohol decreases the ability of the brain to make use of oxygen.*
 - *Visual symptoms include eye muscle imbalance, which leads to double vision and difficulty focusing.*
 - *Inner ear effects include dizziness and decreased hearing perception.*

- *If other variables are added, such as sleep deprivation, fatigue, medication use, altitude hypoxia, or flying at night or in bad weather, the negative effects are significantly magnified.*

1.17 Organisational and management information

1.17.1 Not applicable.

1.18 Additional information

1.18.1 Microlight aircraft operate under CAR Part 91, *General Operating and Flight Rules* and CAR Part 103, *Microlight Aircraft – Certification and Operating Rules*. The latter Rule Part details exceptions to Part 91 pertaining specifically to the operation of microlight aircraft.

1.18.2 CAR Part 19 *Transition Rules* states:

19.7 Intoxicating liquor and drugs

No crew member while acting in his or her official capacity shall be in a state of intoxication or in a state of health in which his or her capacity so to act would be impaired by reason of his or her having consumed or used any intoxicant, sedative, narcotic, or stimulant drug or preparation.

1.18.3 While CARs do not stipulate any specific limits for alcohol or drug use, there is a common adage used as a guide within the aviation industry which states “Eight hours between bottle and throttle”.

1.18.4 As a matter of interest, the United States Federal Aviation Administration requires:

Federal Aviation Regulation (FAR) 91.17

The use of alcohol and drugs by pilots is regulated by FAR 91.17. Among other provisions, this regulation states that no person may operate or attempt to operate an aircraft:

- *within eight hours of having consumed alcohol,*
- *while under the influence of alcohol,*
- *with a blood alcohol content of 0.04% or greater,*
- *while using any drug that adversely affects safety.*

1.19 Useful or effective investigation techniques

1.19.1 Not applicable.

2. Analysis

- 2.1 The aerodrome has runway lighting which enables night operations. The aircraft, although legally limited to only 'Day VFR Operations', was equipped with instrument lighting, an artificial horizon instrument, a directional indicator, landing and strobe lighting. The aircraft was therefore reasonably well equipped for night operations and was capable of being flown at night.
- 2.2 The weather was unsuitable for VFR night operations. The strong south-east weather pattern, bringing rain showers and reduced visibility, had been affecting the region for the previous 48 hours as evidenced by the large volume of surface water in the immediate surrounding area.
- 2.3 The weather conditions at the time of the accident forced the rescue helicopter pilot to suspend operations and remain at the Wairoa Hospital until at least daylight to await an improvement in the weather. The statement from the Wairoa resident, who heard the aircraft noise, accurately noted the time and heard the rain, which confirms that those conditions were present at the time.
- 2.4 The hospital was 3 kms from the aerodrome and the resident's home was 2 kms away. The aircraft was flying toward the township, into the wind and the approaching band of rain. The minimum horizontal visibility for VFR night flight was eight kilometres for night flying capable aircraft.
- 2.5 This would have been a challenging flight at night even if the instructor and pilot's performance had not been impaired. The decision of the helicopter pilot to remain on the ground confirmed the challenging flying conditions at the time.
- 2.6 For comparison purposes, the legal blood/alcohol limit in New Zealand for driving a motor vehicle is 80 milligrams of alcohol per 100 millilitres of blood. The instructor's blood/alcohol level was 320 milligrams and the pilot's 236 milligrams, about four and three times respectively over the legal driving limit.
- 2.7 The instructor, who occupied the right seat, had previously been rated for night operations but was not current to carry passengers or to instruct in night flying at the time of the accident.
- 2.8 The pilot in the left seat had no recorded previous night flying experience, and it is unlikely that he had a discernable horizon with which to align the aircraft attitude.
- 2.9 Initially it was assumed that the aircraft had crashed almost immediately after takeoff due to the aircraft being found just off the extended centreline of the runway. However due to other evidence such as:
- the Hobbs meter indicating at least six minutes of flight time,
 - the aerodrome witness's statement that he thought he saw the aircraft in the downwind part of the circuit heading towards the Wairoa township,

- the Wairoa resident's statement of hearing the aircraft approaching, then turning away from the township, coupled with his accurate recollection of the time, and
- the flap and elevator trim configuration being in preparation for landing,

it is likely that the accident occurred as the aircraft was returning to the aerodrome.

- 2.10 After take-off and turning left, the instructor may have had a diminished view of the township lights and the runway lights with which to align the aircraft attitude. In returning to overhead the aerodrome after a 180 degree turn away from the township lights, the runway lights would have provided the necessary visual cues, but after passing overhead the aerodrome, the dark surroundings would not have provided any visual cues and it is likely that the instructor suffered spatial disorientation. Once an aircraft enters conditions under which the pilot cannot see a distinct visual horizon, errors in the perceived rate of turn about any axis can build up and these errors will build up to a point that control of the aircraft is lost, usually leading to a steep, diving turn.
- 2.11 While passing over the aerodrome and looking into darkness, subtle changes would have been occurring in preparation for descent and landing, with a significant pitch change once the engine power was reduced and flaps extended. Critical in combination with these changes is the possibility of a slow lateral roll developing due to the slight flap asymmetry. In daylight this would have been easily compensated for with the assistance of visual cues from the horizon.
- 2.12 These subtle trim changes, if not compensated for in the darkness, would have caused an unusual attitude of the aircraft to develop due to spatial disorientation of the pilot and instructor. The effects of alcohol on the inner ear balance mechanisms of both occupants could have exacerbated the situation.
- 2.13 The discovery of the slight flap asymmetry during the detailed inspection of the aircraft (while probably only about a three degree difference) may have been why the aircraft had always been out-of-trim, requiring aileron trim to compensate.
- 2.14 The fuel selector position caused some concern early in the investigation, because there was no cabin lighting near the fuel selector and it was possible that inadvertent selection of the mid-travel position had cut off the fuel supply to the engine. This possibility was eliminated by subsequent testing and research.

3. Conclusions

- 3.1 The instructor and pilot were both intoxicated with alcohol, and the pilot may have recently used cannabis. As a result, their judgement and flying performance would have been impaired.
- 3.2 The meteorological conditions were below those required for VFR night operations.
- 3.3 The aircraft was not certified for night VFR flight.
- 3.4 The instructor, although previously night rated, had not maintained currency.
- 3.5 The pilot had no recorded night flying experience.

- 3.6 It is probable that the pilot and instructor became spatially disorientated after losing reference to the ground lights and/or flying into low cloud and rain.
- 3.7 Power and trim changes occurring in preparation for landing are likely to have contributed to the spatial disorientation which then probably led to the loss of controlled flight.
- 3.8 The dangers of flying while under the influence of alcohol and/or drugs are well known amongst pilots, as are the requirements for night flying currency and adherence to meteorological minima.
- 3.9 Unusual attitude training, including recognition and recovery, is a pilot training syllabus requirement. Successful recovery of the aircraft from an unusual attitude situation at very low altitudes is unlikely however, such as in this accident.

Report written by:

Tom McCready
Safety Investigator

Authorised by:

Peter Kirker
Manager Safety Investigation

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Civil Aviation Authority of New Zealand
Aviation House, 10 Hutt Road, Petone
P O Box 31441, Lower Hutt 5040
NEW ZEALAND

Tel: +64-4-560 9400 Fax: +64-4-569 2024
www.caa.govt.nz