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Wake turbulence event involving a Boeing 737, VH-YIO

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Wake vortices

Source: NASA

On 13 September 2012, at about 1619 Coordinated Universal Time (UTC)[1], a Virgin Australia Boeing 737 aircraft (B737), registered VH-YIO (YIO), departed Bali International Airport (Denpasar), Indonesia on a scheduled passenger service to Brisbane, Queensland. On board the aircraft were six crew and 132 passengers. The first officer (FO) was designated as the pilot flying.

During the climb, the crew requested a cruise altitude of flight level (FL)[2] 370 from Indonesian air traffic control (ATC), however, due to traffic at FL360, the crew were assigned FL350. The crew reported calm wind conditions at the time.

At 1639, the aircraft became established in the cruise and the seat belt sign was turned off. Shortly after, the crew observed opposite direction traffic on the aircraft's traffic alert and collision avoidance system (TCAS), about 1,000 ft above and slightly to the left. The crew observed the aircraft pass to the left. Airservices Australia surveillance data indicated the aircraft passed at about 1640, with about 0.9 NM lateral and 1,400 ft vertical separation (Figure 1).

At 1641, the FO reported that they felt 'cobblestone' like turbulence. The aircraft then experienced a wake-induced roll, initially to the right and then suddenly to the left, which the crew estimated to be to an angle of 45°. The crew received an enhanced ground proximity warning system (EGPWS) bank angle warning and the autopilot control wheel steering mode[3] engaged. As the roll to the left commenced, the crew immediately responded by applying full right aileron deflection. The crew reported that the aircraft initially continued to roll left, but the roll then arrested and straight-and-level flight was resumed.

Radar surveillance data indicated that, at the time of the event, there was about 2.1 NM lateral and 1,400 ft vertical separation (Figure 2) between the aircraft and the correct ATC separation standards were being applied at the time.

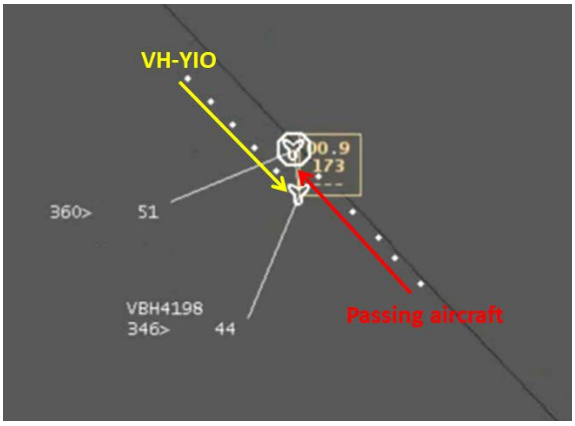
The captain spoke to the cabin supervisor (CS) who advised of nil injuries. He then contacted ATC requesting information on the passing aircraft. Air traffic control advised that the aircraft was an Airbus A380 (A380) aircraft operated by Emirates. The captain then made a passenger announcement over the public address system (PA) and also went out into the cabin. He spoke to the CS again who advised that all the passengers were seated at the time of the incident. The flight continued without further incident.

1 Coordinated Universal Time (abbreviated UTC) is the time zone used for civil aviation. Local time zones around the world can be expressed as positive or negative offsets from UTC.

2 At altitudes above 10,000 ft, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 370 equates to 37,000 ft.

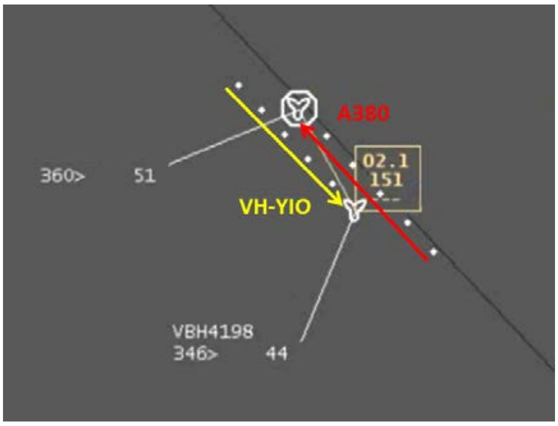
3 Autopilot mode giving manual control of heading; aircraft speed and/or attitude are maintained by the autopilot.

Figure 1: Aircraft positions at time of passing



Source: Airservices Australia

Figure 2: Incident location



Source: Airservices Australia

Recorded information

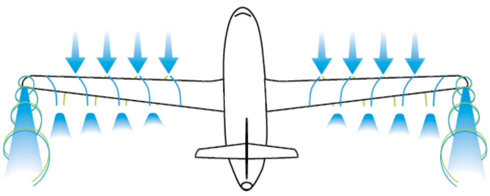
The B737 flight data recorder (FDR) was downloaded from the aircraft and the data provided to the Australian Transport Safety Bureau (ATSB). The data indicated that the aircraft initially rolled to the right to a maximum angle of 6.5° and then left to 40.4°, with a 40 ft loss in altitude. It also showed that the crew's control inputs had commenced before the maximum left roll angle was achieved, which subsequently reduced the aircraft's roll rate. The duration of the incident was about 10 seconds.

Wake turbulence

The phenomenon that creates wake turbulence results from the forces that lift the aircraft. Lift is produced by a differential in pressure over the wing surfaces. High pressure air below an aircraft's wing flows around the wingtips to the low pressure air on top of the wing. This results in vortices being generated from the wings. When viewed from behind, the left wing vortex rotates clockwise and the right wing vortex rotates counter-clockwise. The region of rotating air behind the aircraft is where the wake turbulence occurs (Figure 3). The strength of the vortices is predominantly determined by the weight, speed and wingspan of the aircraft.

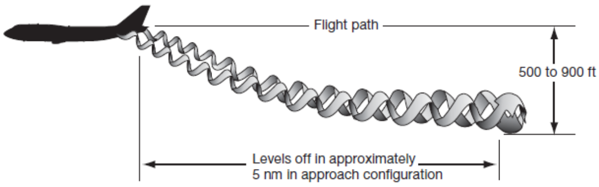
Wake vortices spread laterally away from the aircraft and generally descend at an initial rate of about 300 to 500 feet per minute for about 30 seconds. The descent rate decreases and eventually approaches zero when about 500-900 ft below the flight path (Figure 4). The life span of the wake vortices is about 30 seconds for a wind speed of 5-10 kts; up to 85 seconds for wind speeds less than 5 kts; and up to 100 seconds in still air.

Figure 3: Wake vortices



Source: New Zealand Civil Aviation Authority

Figure 4: Movement of wake vortices



Source: Flight Safety Foundation

A380 wake vortex safety report[4]

In June 2008, the A380 Wake Vortex Steering Group published the *Safety Case for Wake Vortex Encounter Risk due to the Airbus A380-800* (4th Ed.). One of the key objectives of the safety case was to define and justify the safety requirements for the A380 to ensure that the wake vortex encounter (WVE) risk was acceptably low. The results indicated that, based on data collected since 2006, the WVE risk was considered acceptable and the current vertical or horizontal separation criteria used by ATC (ICAO Procedures for Air Navigation Services — Air Traffic Management) remained applicable to the A380. Furthermore, it showed that the WVE risk that resulted from an A380 during the cruise was not noticeably different from that of aircraft such as the Boeing 747-400 (B747), Airbus A340-600 (A340) and Boeing 777-300. Appendix A provides a summary of a selection of wake turbulence occurrences reported to the ATSB involving the A380, the B747 and the A340, during the cruise phase of flight.

A380 wake turbulence classification

The wake turbulence separation standards applied by ATC are determined by grouping aircraft into four categories (light, medium, heavy and super) based on the aircraft's maximum certified take-off weight. The A380 is the only aircraft currently assigned the category of 'super'.

Guidance issued by the International Civil Aviation Organization (ICAO) on the subject of Airbus A380 wake vortex aspects states that[5]:

> For A380-800 aircraft the expression "SUPER" should be included immediately after the aircraft call sign in the initial radiotelephony contact between such aircraft and ATS [air traffic service] units.

Prior to the incident, at about 1624, the crew of a preceding aircraft also outbound from Denpasar heard a broadcast from opposite direction traffic. The term 'Super' was used as part of that broadcast, which alerted the crew that the traffic ahead was an A380. The A380 was at about 1,000 ft above. The captain reported that, as the wind conditions at the time were light, he predicted that there would be little 'drift' of the A380's wake vortices. Consequently, to avoid any possible wake turbulence, at about 1629, the crew requested a 5 NM diversion off track from ATC. The captain reported that no wake turbulence was experienced and the flight proceeded normally.

The captain of YIO could not recall hearing a broadcast regarding the A380.The FO recalled hearing broadcasts from several aircraft operating on the frequency at the time, but could not recall hearing any broadcasts with the term 'Super' appended. The FO reported that, if he was aware that the passing aircraft was an A380, he would have considered deviating off track as a precaution.

An Airbus Flight Operations Briefing Note on *Wake Turbulence Awareness/Avoidance* also recommends that, during the cruise (if necessary), the crew may offset from the cleared track by up to a maximum of 2 NM, in order to alleviate the effects of wake turbulence[6].

Jet upset recovery training

A 'jet upset' occurs when the aircraft unintentionally exceeds the parameters normally experienced in flight: where the nose up pitch attitude is greater than 25°; or the nose down pitch attitude is greater than 10°; or the bank (roll) angle is greater than 45°; or within the above parameters, but flying at airspeeds inappropriate for the conditions.

The captain reported conducting his 6 monthly jet upset simulator training within the week prior to the incident, while the FO had completed his training about 2 months before. While, based on the above criteria, a jet upset did not occur; both the captain and FO reported that the training was invaluable. The FO further stated that his response to the wake turbulence encounter was instinctive and that the incident was similar to that experienced in the simulator.

4 www.jaa.nl/operations/Public%20Area/SafetyCase%20v4%200%2020Jun08%20(2).pdf
5 www.skybrary.aero/bookshelf/books/160.pdf
6 www.airbus.com/fileadmin/media_gallery/files/safety_library_items/AirbusSafetyLib_-FLT_OPS-OPS_ENV-SEQ07.pdf

Pilot comments

The crew provided the following comments regarding the incident:

- **Seat belts***:* The captain reported that, when he made a PA to the passengers advising that the seat belt sign had been turned off, he encouraged them to keep the belt fastened when seated. The FO also stated that, due to the time of the incident the majority of passengers were sleeping, with their seat belts secured.
- **Track offset***:* The FO reported that, when conducting international operations, he had observed some aircraft diverting off track slightly to minimise the effects of wake turbulence from passing aircraft.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Virgin Australia

As a result of this occurrence, Virgin Australia has advised the ATSB that they have issued a notice to all flight crew detailing the incident involving VH-YIO and summaries of other wake turbulence incidents involving Virgin Australia aircraft.

Safety message

Recurrent training

Periodic recurrent training ensures that pilots continue to be knowledgeable of, and proficient in their specific aircraft type, and operating procedures: pilots are better prepared for responding to a situation. This incident demonstrated the value of such training, allowing the crew to react to the wake turbulence encounter intuitively and promptly.

Seat belts

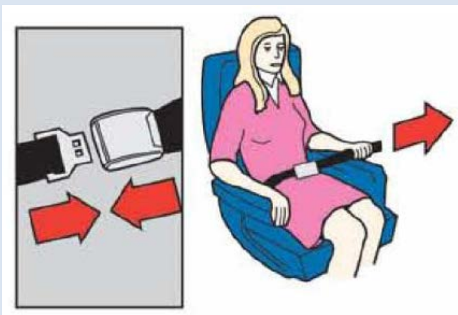
A wake turbulence encounter can be a surprising experience for both the crew and passengers and usually results in induced rolling or pitch moments. A safety bulletin published by the ATSB in June 2008, *Staying Safe against In-flight Turbulence*, noted that almost all turbulence[7] injuries involve people who are not properly seated and do not have their seat belt fastened. This incident is a timely reminder of the benefits of having the seat belt fastened, even when the seat belt sign is turned off, so that injuries during a turbulence encounter can be minimised.

Staying Safe against In-flight Turbulence

What can you do to stay safe?

- Put your seatbelt on, and keep it fastened when you are seated.
- Pay attention to the safety demonstration and any instructions given by the cabin crew.
- Read the safety information card in your seat pocket.

www.atsb.gov.au/media/27791/ar2008034.pdf



7 This may include thunderstorm turbulence, mountain wave turbulence, wake turbulence, or clear air turbulence.

The following publications provide additional information on wake turbulence:

- Federal Aviation Administration Advisory Circular AC 90-23F ' Aircraft wake turbulence'
www.rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/list/AC%2090-23F/$FILE/AC90-23f.pdf
- Flight Safety Foundation 'Airplane Upset Recovery Training Aid'
www.flightsafety.org/archives-and-resources/airplane-upset-recovery-training-aid
- New Zealand Civil Aviation Authority 'Wake Turbulence'
www.caa.govt.nz/safety_info/gaps/wake_turbulence.pdf
- United Kingdon Civil Aviation Authority aeronuatical information circular 'Wake Turbulence'
www.skybrary.aero/bookshelf/books/1166.pdf
- Wake turbulence training aid
www.ntl.bts.gov/lib/42000/42200/42251/DOT-VNTSC-FAA-95-04.pdf

Appendices

Appendix A – Other wake turbulence occurrences (cruise)

- During the cruise, an opposite direction B747 passed 1,000 ft above. The crew observed the wake and immediately requested a diversion left of track from ATC. The aircraft experienced significant roll (ATSB occurrence 200802765).
- While maintaining FL370, in smooth air, the aircraft encountered moderate to severe turbulence from a passing B747 at FL380. The turbulence was reported as a 'thump' and of sufficient strength to alarm the crew and passengers (ATSB occurrence 200808246).
- During the cruise, moderate wake turbulence was experienced from a preceding A380, 33 NM ahead (ATSB occurrence 200900625).
- During the cruise, an A380 passed about 1,000 ft above. About 1 minute later, significant turbulence was experienced, with bank angle excursions to the left and right of up to 20°. After about 30-45 seconds, normal flight was resumed. Nil wind conditions were reported at the time (ATSB occurrence 200900778).
- While maintaining FL370, in smooth air, the aircraft experienced 'abrupt' moderate to severe turbulence for about 2 seconds. The crew were subsequently advised by ATC that an A380 had crossed their path on descent (ATSB occurrence 200900783).
- An opposite direction B747 passed 1,000 ft above. Shortly after, strong wake turbulence was experienced, resulting in the aircraft rolling left and right, and the autopilot and auto-throttle disengaging. The aircraft climbed about 280 ft above it's cruise altitude of FL390 (ATSB occurrence 201003614).
- While maintaining FL390, an opposite direction A380 passed 1,000 ft above. Soon after, the aircraft experienced wake turbulence for about 10 seconds, with minimal displacement in roll and pitch. Light and variable wind conditions were reported (ATSB occurrence 201009234).
- While maintaining FL360, an opposite direction A340 passed 1,000 ft above. The crew reported experiencing severe wake turbulence and a loss of control resulting in an angle of bank exceedance greater than 40° (ATSB occurrence 201100111).
- While maintaining FL390, a B747 passed the aircraft about 1 NM away and 1,000 ft above. Shortly after, the aircraft experienced moderate wake turbulence for about 10-15 seconds (ATSB occurrence 201101069).
- While maintaining FL310, severe to moderate wake turbulence was experienced from an opposite direction A380, which passed 1,000 ft above and 3-5 NM to the right of track (ATSB occurrence 201103206).

- During the cruise, in smooth air, the aircraft abruptly rolled left 10° injuring two cabin crew members. About 2 minutes prior, a B747 was observed passing the aircraft to the left, about 2 NM away and 1,000 ft above (ATSB occurrence 201104284).
- About 90 seconds after passing an opposite direction A380, 1,000 ft above, moderate turbulence was experienced (ATSB occurrence 201105306).
- During the cruise, shorts bursts of severe wake turbulence were experienced from an A380. A cabin crew member received injuries (ATSB occurrence 201202150).

Additionally, the ATSB conducted an investigation (AO-2008-077) into an A380 wake turbulence encounter during the approach phase of flight, where a passenger sustained minor injuries. When tracking to join a 7 NM final and descending through about 2,400 ft, the aircraft experienced an uncommanded 52° roll to the left, in conjunction with an 8° nose-down pitching moment. Immediately after, the aircraft rolled through wings level to a 21° right bank angle. The aircraft also experienced an altitude loss of 300-400 ft. The momentary upset was likely the result of wake turbulence from an A380 conducting a parallel approach.

General details

Registration:	VH-YIO	
Manufacturer and model:	The Boeing Company 737-8FE	
Operator:	Virgin Australia Airlines	
Type of operation:	Air transport – high capacity	
Occurrence category:	Serious incident	
Primary occurrence type:	Turbulence event	
Location:	258 km SE of Bali International Airport (Denpasar), Indonesia	
	Latitude: 10° 26.40' S	Longitude: 116° 47.13' E
Persons on board:	Crew – 6	Passengers – 132
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Windshield cracking event involving a Cessna Aircraft Company 750, VH-RCA

What happened

Cessna Citation 750, VH-RCA

Source: ATSB

On 15 January 2013, at about 1500 Coordinated Universal Time (UTC[1]), a Cessna Citation 750, registered VH-RCA (RCA) departed Faleolo International Airport, Samoa for Sydney Airport, New South Wales, with two flight crew and five passengers on board. The aircraft initially climbed to flight level[2] (FL) 340 and approximately 1 hour 35 minutes into the flight, the aircraft climbed to FL450.

Shortly after levelling at FL450, the crew reported that a WSHLD HEAT INOP L (windshield heat inoperative left) message was displayed on the EICAS[3]. The crew consulted the appropriate checklist, with the only action to leave icing conditions as soon as practical. The pilot flying (PF) reported that the left windshield was warm to the touch and that approximately 2 minutes later, the windshield outer ply shattered with a loud bang. The left and right windshield heat switches were subsequently switched to OFF. The flight crew completed the emergency depressurisation checklist, donned their oxygen masks and deployed the passenger oxygen masks. An immediate descent was commenced along with a turn towards Nadi International Airport, Fiji, which was one of the planned alternate airports. The PF declared a Mayday[4] which was acknowledged by Nadi radio. Once the descent was established, the pilot not flying (PNF) ensured passengers were on oxygen and briefed them on the situation. The cabin was prepared for a possible ditching, with the passengers directed by the PNF to don their life vests and review the safety briefing card. The PF reported that the windshield cracking remained constant during the descent and did not progress further. The cabin did not depressurise, and once at FL140 and with the cabin altitude stabilised, the passengers were directed to remove their oxygen masks. The mayday was downgraded to a PAN[5] and the flight continued to Nadi without further incident. There were no injuries to passengers or crew.

Windshield examination

The aircraft returned to Sydney on 26 January 2013 with no passengers on board. Subsequent examination of the left electrically heated glass windshield (part number 9914380-11) by the ATSB showed that the outer ply had shattered across the entire surface (Figure 1). A brown discolouration was observed towards the top right of the windshield (facing forward) along with staining around one of the soldered contacts (Figure 2). The damage was confined to the outer layer of the windshield.

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1 Coordinated Universal Time (abbreviated UTC) is the time zone used for civil aviation. All times used in this report are in UTC.

2 At altitudes above 10,000 ft, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 370 equates to 37,000 ft.

3 Engine-indicating and crew-alerting system

4 Mayday is an internationally recognised radio call for assistance

5 An internationally recognised radio call announcing an urgency condition which concerns the safety of an aircraft or its occupants but where the flight crew does not require immediate assistance.

A review of the aircraft maintenance documentation showed that the left windshield, serial number 05123H7884, had been installed on 5 July 2005 and had accumulated approximately 3,200 hours and 2,050 flight cycles since that time.

Figure 1: Shattered left windshield external (left) and internal (right)

Source: ATSB

Windshield system description

The windshields were of a laminated glass construction, with an outer, middle and inner pane of glass. The middle and inner panes comprised the structural component of the windshield, and either pane was structurally capable of maintaining cabin pressure. There was a heated interlayer between the outer and middle glass panes.

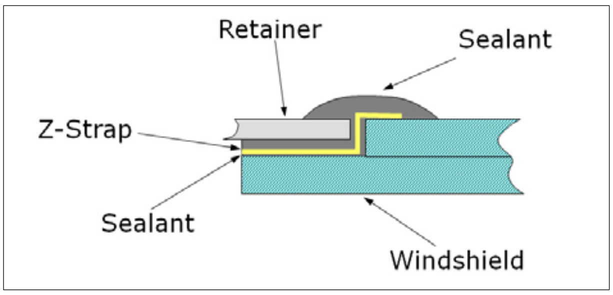
The windshield heating system consisted of a left and right component that included an AC alternator, a 3-phase circuit breaker, a heat controller and the windshield. The heat controller used temperature feedback from the windshield to control the supplied power, with a normal operating temperature of 43 °C. Each windshield had three heating zones, one for each phase of AC power, which were arranged vertically. Bus bars at the top and bottom of the windshield connected the wiring to the heater film through a braided wire lead which was soldered to the bus bar. Power flowed from the braided wire into the upper bus bar and was distributed to the thin metal oxide heating film, grounding in the same manner at the lower bus bar.

Manufacturer's comments

The manufacturer reported that they had experienced two reliability issues with windshield part number 9914380-11/-12.

The first issue was related to moisture ingress. Wear of the seal at the top of the windshield could allow moisture ingress to the bus bar and lead to degradation of the electrical connection between the bus bar and the heating film which could eventually begin to burn out. This could result in arcing that could eventually lead to failure of the outer non-structural face ply of glass. The manufacturer addressed the issue by adding a fiberglass z-strap along the boundary of the face ply to add an additional moisture protection layer and to also provide an indicator of seal wear.

Figure 2: Schematic showing location of z-strap



Source: Cessna Aircraft Company

The second issue was a breakdown of the bus bar at the bus bar solder joint as a result of differing thermal coefficients of expansion between the solder and bus bar material. Thinner bus bars (as a result of normal variation in production) were susceptible to progressively crack until the electrical circuit was opened and arcing began. The extreme heat and pressure build-up of locally vaporized interlayer material due to the arcing would then eventually lead to failure of the non-structural face ply. The issue was addressed by increasing the size and mass of the upper bus bar and moving it down sufficiently to allow for inspections if required.

The above changes were incorporated into part number 9914380-13/-14 which was released to service in early 2008. There have been no reported cases of either of these failure modes in the -13/-14 windshields.

ATSB comment

The windshield from VH-RCA had likely been affected by moisture ingress resulting in a degradation of the electrical connection between the bus bar and the heating film. The ATSB is satisfied that the issues leading to the non-structural failure of windshield part numbers 9914380-11/-12 have been addressed by the manufacturer.

Safety message

While the failure of the windshield involved the outer pane only, and did not result in a depressurisation, the precautions taken by the flight crew to descend to a lower altitude and diversion to the alternate airport highlighted the importance of good flight planning.

General details

Manufacturer and model:	Cessna Aircraft Company Citation 750	
Registration:	VH-RCA	
Type of operation:	Aerial work	
Primary occurrence type:	Windshield cracking	
Occurrence category	Incident	
Location:	460 km south-east of Nadi International Airport, Fiji	
	Longitude: S 22° 25.15'	Latitude: E 178° 30.18'
Persons on board:	Crew – 2	Passengers – 5
Injuries:	Crew – nil	Passengers – nil
Damage:	Minor	

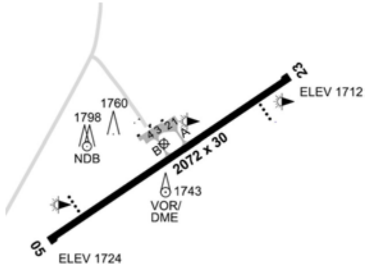
Turboprop aircraft

Airspace related event involving Beech 1900C, VH-KFN and Aerospatiale AS350 B2, VH-VRW

What happened

On 6 September 2012, an Aerospatiale AS350 B2 helicopter, registered VH-VRW (VRW), was being used to conduct aerial work out of Rhodes Ridge, Western Australia. After ferrying personnel from Rhodes Ridge to a survey site about 28 km north-east of Newman, the pilot of VRW flew to Newman aerodrome to refuel and to have a minor unserviceability rectified. On arrival, he was advised that neither the refuellers nor the engineers were available. After waiting some time, the pilot was advised that one of the people at the survey site had been injured and required evacuation. The helicopter was then refuelled at the fuel bowser.

Newman aerodrome



Source: Airservices Australia

At about the same time, the crew of a Beech 1900C, registered VH-KFN (KFN), taxied for departure on runway 05. The crew made all necessary very high frequency (VHF) radio transmissions on the Common Traffic Advisory Frequency (CTAF). At 1300 Western Standard Time[13], as the aircraft commenced the takeoff roll, the pilot in command (PIC) of KFN heard the pilot of VRW transmit a taxi call but did not expect the helicopter to commence a takeoff.

As the aircraft passed about 300 to 450 m down the runway, at a speed of about 80 knots, the PIC of KFN saw VRW tracking across the GA apron towards the runway. As KFN passed a point about 100 m before taxiway Bravo (Figure 1), the PIC of KFN observed VRW enter the runway strip, turn left and takeoff parallel to runway 05. Shortly after, the co-pilot had called V_1[14] and V_R[15] (108 and 109 knots respectively). The PIC of KFN believed the path of VRW could conflict with KFN if they became airborne and, although KFN was at about 120 knots, he elected to reject the takeoff. As the aircraft slowed, the PIC of KFN observed VRW turn right and cross the runway about 200 m in front of KFN and about 200 ft above ground level.

The pilot of VRW only became aware of KFN when he heard the co-pilot transmit ‘KFN aborting’. The pilot of VRW made all necessary radio transmissions but heard only one garbled transmission which may have been KFN’s ‘rolling’ call.

Pilot comments

The pilot of VRW later reported that he felt under pressure to get to the survey site and evacuate the injured person. In his haste to transit to the site, he had turned right across the runway when the normal procedures required him to turn left.

The pilot noted that he had been advised by a third party that the patient required an immediate evacuation, however when he arrived at the site there had been a miscommunication and the patient was happy to stay there for the rest of the day.

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13 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

14 V_1 – Maximum speed during takeoff at which a pilot can safely stop the aircraft without leaving the runway.

15 V_R – Speed at which the rotation of the aircraft is initiated to takeoff attitude.

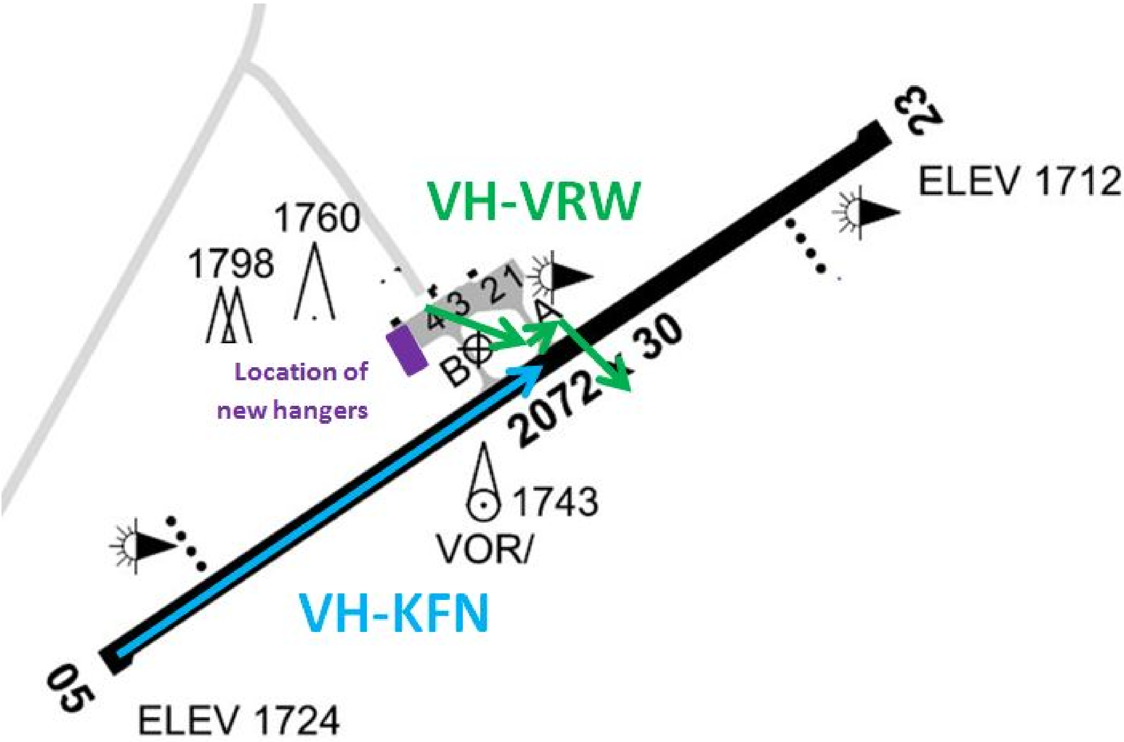
Radio transmissions

VHF transmissions are direct, straight-line (line-of-sight) transmissions and their effectiveness depends upon both the distance between the two stations and whether or not there are obstructions between them. The two stations in this incident were KFN and VRW.

Following the incident, the Newman Airport Manager advised that a number of hangars had recently been built to the west of the GA apron that obscured the view from the GA apron to the threshold of runway 05. The new hangars were also thought to be responsible for blocking radio transmissions between aircraft on the GA apron and those on the threshold of runway 05.

Radio transmissions at Newman are recorded for administrative purposes. A review of the recording for a period immediately before and after the incident showed that both KFN and VRW made all necessary radio transmissions prior to entering the runway. However, transmissions by KFN once on the runway were not recorded, though those made by VRW in the vicinity of the runway were. Recorded transmissions by VRW after the incident were clearly part of a conversation with KFN, though KFN's transmissions were not recorded.

Figure 1: Track of VH-KFN (blue) and VH-VRW (green)



Source: Airservices Australia

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Airfield operator

As a result of this occurrence, the airfield operator has advised the ATSB that they are taking the following safety action:

Aviation Information Publication

The airfield operator is seeking to have the following information included in the aviation information publication for Newman:

Due to possible shielding effects from aircraft hangars along the south-western edge of the GA Apron, helicopter traffic is to adhere to unmanned airfield procedures during arrivals and departures. The circuit is to be joined as per these procedures for approaches on the runway in use, or parallel on the western side thereof. During departures helicopters are to air taxi onto TWY B for departures on the runway in use, or parallel to and on the western side. Departing turns tracking towards the east are only to be executed once clear of the circuit. No departures to the east across the runways should be executed.

Safety message

A study by the National Aeronautics and Space Administration (NASA) found that perceived or actual pressure can contribute significantly to degradation in human performance and behaviour. The study recommended that pilots be particularly cautious if distraction or time pressure are encountered during the pre-flight or taxi phases of a flight. The NASA study is available at http://asrs.arc.nasa.gov/docs/rs/43_Time_Pressure_as_a_Causal_Factor.pdf

Additionally, when responding to an emergency call-out, pilots should consider requesting additional information to determine how serious the emergency actually is. Though this may not always be possible, the information may enable a pilot to better prioritise their activities.

The Civil Aviation Safety Authority (CASA) on-line store has a number of resources to assist pilots to understand the significance of perceived or actual pressures in the aviation environment. These resources include the following resources to assist pilots recognise and manage stress in the aviation environment:

- *Safety behaviours – human factors for pilots*;
- *Operations at non-towered aerodromes*; and
- *Look out!*

The CASA on-line store is available at www.thomaslogistics.com.au/casa/index.html

The ATSB has released *A pilot's guide to staying safe in the vicinity of non-towered aerodromes* AR-2008-044(1), available at www.atsb.gov.au/publications/2008/ar-2008-044(1).aspx.

General details

Occurrence details

Primary occurrence type:	Airspace related event	
Occurrence category:	Incident	
Location:	Newman Aerodrome, Western Australia	
	Latitude: S 23˚ 25.07´	Longitude: E 119˚ 48.17´

Beech 1900C, VH-KFN

Manufacturer and model:	Beech 1900C	
Registration:	VH-KFN	
Type of operation:	Charter	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Aerospatiale AS.350 B2, VH-VRW

Manufacturer and model:	Aerospatiale AS.350 B2	
Registration:	VH-VRW	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Runway loss of separation between Bombardier DHC-8-202, VH-ZZJ and Aerospatiale AS332 L1, VH-LOJ

What happened

Darwin Airport

Source: Google Earth

Between 1440 and 1533 Central Standard Time[16], on 4 September 2012, an Aerospatiale AS332 L1 helicopter, registered VH-LOJ (LOJ), was being used to conduct flying training operations on runway 36, at Darwin Airport, Northern Territory (Figure 1). For the majority of the time, LOJ was restricted to operate south of runway 29.

At 1524, a Bombardier DHC-8-202, registered VH-ZZJ (ZZJ), reported ready for departure on runway 29 and was instructed to line-up behind a landing aircraft from taxiway Echo 2 (E2). The landing aircraft vacated the runway and, while ZZJ was still taxiing onto the runway at 1526, the Aerodrome Controller (ADC) cleared the aircraft for takeoff.

At 1528, and before ZZJ had commenced the takeoff roll on runway 29, LOJ called ready on runway 36 for departure to the north. The ADC cleared LOJ for takeoff and instructed the pilot to maintain upwind. The instruction to 'maintain upwind' effectively cancelled the restriction on LOJ to operate south of runway 29 and required the helicopter to continue tracking northbound after takeoff, i.e. not to turn left or right.

The pilot of ZZJ heard the transmission and, believing that there would have been a risk of a collision if he commenced takeoff, delayed his departure until after LOJ had crossed the intersection of the two runways.

Defence investigation

Air traffic services at Darwin are provided by the Department of Defence (Defence). The Defence investigation found that an unsafe takeoff clearance had been issued to LOJ, resulting in a runway separation breakdown. Further, the ADC failed to monitor both ZZJ and LOJ during the takeoff, a critical phase of operation. The actions of the pilot of ZZJ, by delaying the takeoff, reduced the potential severity of the incident.

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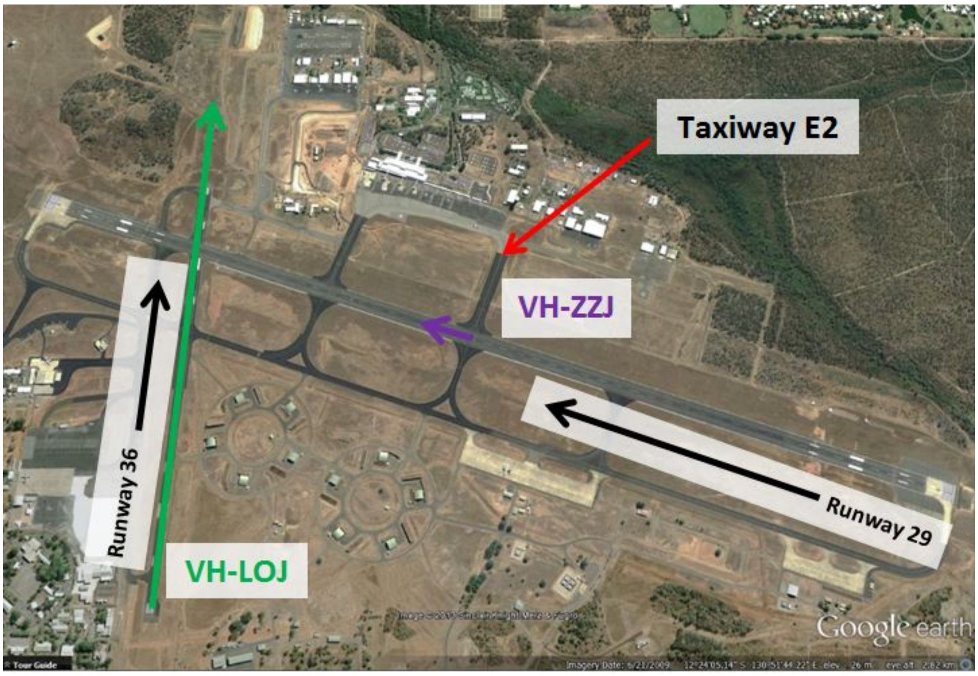
16 Central Standard Time (CST) was Coordinated Universal Time (UTC) + 9.5 hours.

Figure 1: Track of VH-LOJ (green) and position of VH-ZZJ (purple)



Source: Google Earth

ATSB comment

The pilot of ZZJ did not query the ADC's instructions at the time and did not report the incident until two days later. The pilot of LOJ was not aware of the incident and the ADC did not recall the incident.

General details

Occurrence details

Primary occurrence type:	Loss of separation assurance	
Occurrence category:	Incident	
Location:	Darwin Airport, Northern Territory	
	Latitude: S 12° 24.88'	Longitude: E 130° 52.60'

Bombardier DHC-8-202, VH- ZZJ

Manufacturer and model:	Bombardier DHC-8-202
Registration:	VH- ZZJ
Type of operation:	Aerial work
Damage:	None

Aerospatiale AS.332L1, VH- LOJ

Manufacturer and model:	Aerospatiale AS.332L1
Registration:	VH- LOJ
Type of operation:	Flying training
Damage:	None

Pilot incapacitation event involving a Hawker B200, VH-FDT

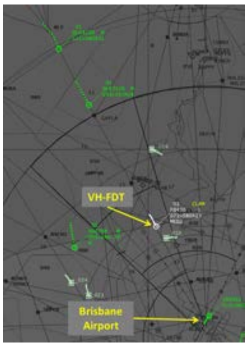
What happened

The information presented below was prepared from information supplied to the ATSB by the operator, the flight nurse, and Airservices Australia.

On 5 November 2012, at about 1530 Eastern Standard Time[17], a Hawker B200 aircraft, registered VH-FDT (FDT), departed Bundaberg on an aeromedical retrieval flight to Brisbane, Queensland. On board the aircraft were the pilot, the flight nurse and two patients.

At 1538, the pilot advised Brisbane Centre air traffic control (ATC) that they were maintaining flight level (FL)[18] 170.

Aircraft position at 1607



Source: Airservices Australia

Prior to, and during the flight, the nurse had reported feeling nauseous. Consequently, the pilot advised the nurse that they may experience turbulence during the descent. The nurse briefed the patients accordingly and returned to her seat, directly behind the pilot facing backwards, and secured her seat belt. The nurse then turned her very high frequency (VHF) radio off as the constant communications were contributing to her feeling nauseous.

At 1543, the pilot received a clearance from Brisbane Centre to descend to 8,000 ft when ready; the pilot read back the clearance. With the autopilot engaged, the pilot selected 8,000 ft on the aircraft's altitude selector and activated the vertical navigation (VNAV) mode[19].

In preparation for the commencement of the MALENY EIGHT standard arrival route (STAR), the pilot reported also selecting an engine power setting of about 950 foot pounds of torque (ft/lb Tq) per engine.

At 1547, the pilot advised Brisbane Centre that he had commenced descent.

At 1556, Brisbane Centre instructed the pilot to contact Brisbane Approach. No response from the pilot was received. At that time, the aircraft was observed on Airservices Australia surveillance data descending through FL118 (Figure 1).

Between 1556 and 1607, Brisbane Centre and Brisbane Approach attempted to contact FDT on 22 occasions, while two aircraft operating in the area also attempted to contact FDT, with no response received.

At 1601, the aircraft was observed levelling off at 8,100 ft.

At 1604, the aircraft was observed maintaining 8,100 ft when passing the instrument flight rules (IFR) waypoint of 'BURPA', which had a requirement to cross at or below 6,000 ft.

As the flight continued, the nurse became concerned as she had not yet sighted the geographic features she normally observed. The nurse then turned her VHF radio on and heard a number of broadcasts from various persons attempting to contact FDT. The nurse turned towards the pilot and observed that his chin was slumped onto his chest and he was not alert.

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17 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

18 At altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 170 equates to 17,000 ft.

19 The VNAV mode maintains a constant descent profile to an assigned altitude entered by the pilot. When the assigned altitude is reached, the aircraft automatically levels off.

The nurse immediately left her seat and attempted to arouse the pilot by shaking his arm. At the same time, the nurse observed the aircraft pitch upwards, coincident with the stall warning alarm activating. The pilot regained alertness and initiated recovery actions. He reported disconnecting the autopilot and applying an amount of engine power. The pilot reported climbing the aircraft to 8,300 ft, although this could not be verified by Airservices Australia surveillance data.

The nurse recalled assessing the pilot as having a Glasgow Coma Scale (GCS)[20] rating of 15/15 within 30 seconds of becoming alert. The nurse returned to her seat and continued to monitor the pilot.

At 1606, the Brisbane Approach controller observed FDT commencing a descent. Shortly after, the cleared level adherence monitoring (CLAM)[21] alarm activated, indicating the aircraft had descended below the assigned level of 8,000 ft.

At 1607, the pilot contacted Brisbane Approach and established communications (Figure 2). After a number of short transmissions between the pilot and Brisbane Approach, the pilot received ATC instructions for approach sequencing into Brisbane.

During the approach, the pilot changed to the Brisbane Tower frequency. Soon after, the nurse observed that the pilot began to hyperventilate, with an increased level of breathing and physical shaking of the hands.

Shortly after, at 1617, the aircraft landed.

The nurse recalled that the landing and subsequent taxi speed appeared faster than normal. During the taxi, the nurse reported that the pilot's emotional and physical state worsened. She encouraged the pilot to complete the after landing checklist and offered reassurance. The nurse also provided the pilot with an oxygen mask (with no oxygen supply) to simulate a 'brown paper bag'. She reported that the pilot's breathing slowed and his physical condition improved slightly.

The aircraft was taxied to the parking area and shutdown.

The nurse advised the pilot that she would organise the patient offload. She then sought assistance for the patients and the pilot. The emotional and physical state of the pilot at the time was reported as poor.

Drug and Alcohol Management Plan (DAMP) testing was conducted and the pilot was transported to hospital for further testing and observation. The DAMP test returned a positive reading for an illicit substance, which had affected the pilot's sleep cycle.

Flight nurse comments

The nurse reported having flown with the pilot on a number of occasions prior to the incident flight, and that his condition and demeanour on the day was normal.

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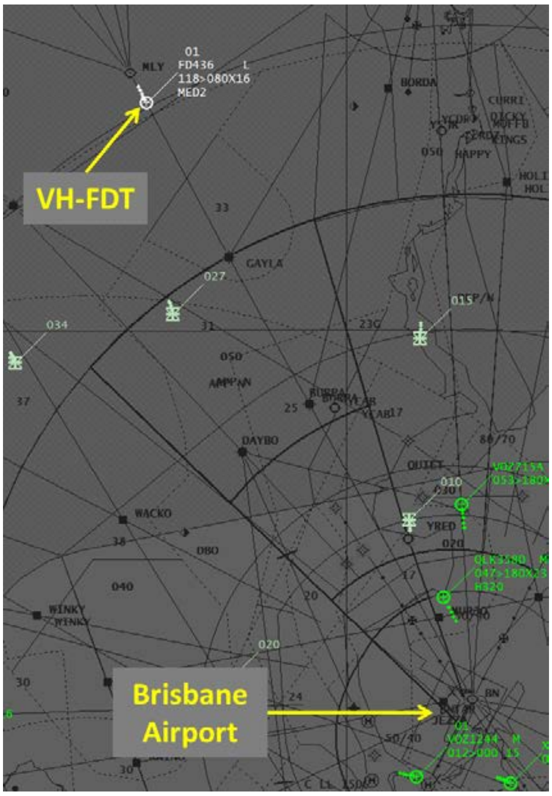
20 The GCS is a neurological scale that aims to give a reliable, objective way to recording the conscious state of a person for initial as well as subsequent assessment. A patient is assessed against the criteria of the scale and the resulting points give a patient score between 3 (indicating deep unconsciousness) and either 14 (original scale) or 15 (the more widely used modified or revised scale).

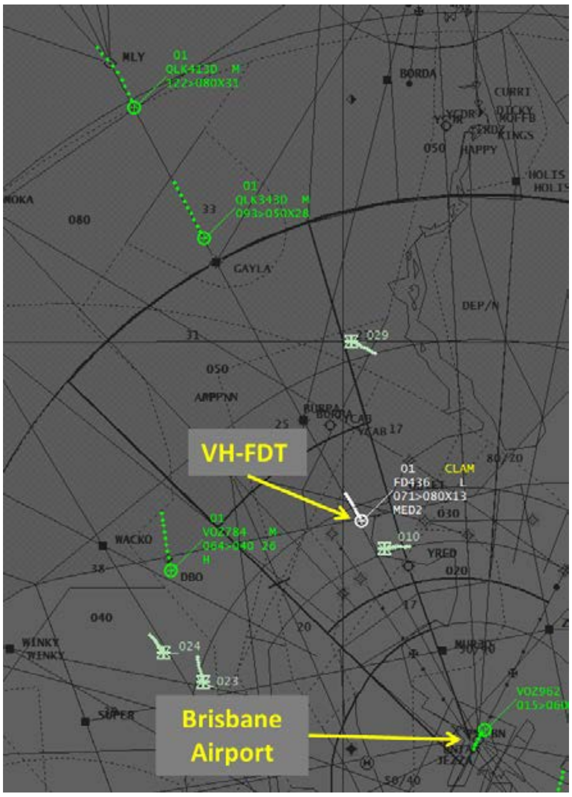
21 The CLAM alert function monitors an aircraft's conformance with the cleared flight level and alerts the controller of any deviation from that clearance.

Figure 1: Aircraft position at 1556



Source: Airservices Australia

Figure 2: Aircraft position at 1607



Source: Airservices Australia

Cabin safety and emergency training

The operator provided cabin safety and emergency training on an annual basis, which included a specific module on pilot incapacitation for flight nurses. The training provided guidance on how to respond to a pilot incapacitation from both a medical and operational perspective. This included using the autopilot, the communications system, the flaps, landing gear and power levers.

The nurse onboard FDT had completed the training about six months prior to the incident. The nurse indicated that more practical training on using the aircraft's communication system would be beneficial. She further stated that, if she was required to use the communication system on the incident flight, it would not have been straight forward. Since the incident, the nurse has received one-on-one practical training with the operator and has been shown how to operate the communications system.

Operator investigation

The operator conducted an internal investigation into the incident and identified that:

- ***Engine power setting**:* With the autopilot engaged, the selected power setting of 950 ft/lb Tq per engine, should have maintained the aircraft level at 8,000 ft, well above the stall warning airspeed. It was likely that the setting was reduced from 950 ft/lb Tq per engine to a lower setting. This indicated that the pilot probably became incapacitated shortly after changing the power setting.
- ***Pilot fatigue**:* Since 1 November 2012, the pilot had reported significant sleep disturbances. At the time of the incident, it was determined that the pilot was experiencing a fatigue level well above that of a normal day worker when ready to retire to bed.
- ***Sustenance**:* Prior to departing Bundaberg, the pilot reported consuming a soft drink and chocolate as he was feeling 'a little low in energy'.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Aircraft operator

As a result of this occurrence, the aircraft operator has advised the ATSB that they are taking the following safety actions:

- ***Random drug and alcohol sample testing***: A comprehensive options paper examining the feasibility of introducing internal random sample testing is currently being prepared and will be presented to the Board in February 2013 for consideration.
- ***Illicit substance education***: Managers will be provided with training on identifying the symptoms and behavioural effects of using an illicit substance.
- ***Cabin safety and emergency training***: Reference material used in the operator's cabin safety and emergency training course regarding pilot incapaciation has been reviewed, with minor changes and additions made.
- ***'First Actions' checklist***: The checklist was developed from existing training material as a quick reference guide for nurses when responding to a pilot incapacitation event.

Safety message

Flying an aircraft is a complex, demanding and challenging activity, which requires a high level of cognitive functioning and psychomotor skills. The significant performance impairments associated with drug use are widely recognised. Consequently, the use of drugs by pilots can adversely affect their ability to safely operate an aircraft.

A Research and Analysis Report conducted by the ATSB, identified that between 1 January 1975 and 31 March 2006, there was a reported 31 accidents and five incidents related to drug and alcohol use. Of this, 14 accidents were related to the use of legal and illegal drugs. Overall, the study showed that the prevalence of drug and alcohol-related accidents and incidents in Australian civil aviation was very low, but the related accident and fatality rates were high. This report is available at www.atsb.gov.au/publications/2006/b20060169_001.aspx.

General details

Registration:	VH-FDT	
Manufacturer and model:	Hawker Beechcraft Corporation B200	
Type of operation:	Aerial work	
Occurrence category:	Serious incident	
Primary occurrence type:	Crew incapacitation	
Location:	70 km NNW of Brisbane Airport, Queensland	
	Latitude: 26° 47.93' S	Longitude: 152° 45.38' E
Persons on board:	Crew – 2	Passengers – 2
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Piston aircraft

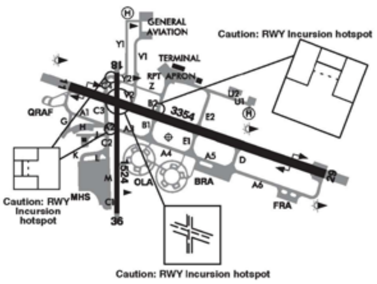
Loss of separation involving a Cessna 310, VH XXT and a Cessna 210, VH RQD

What happened

On 17 February 2012, at about 1315 Central Standard Time[1], a Cessna 210, registered VH-RQD (RQD), was backtracking runway 18 for the general aviation parking area at Darwin airport, Northern Territory.

RQD vacated runway 18 to the left via taxiway Alpha and held short of runway 29 at holding point Charlie 3 (C3) (Figure 1), in accordance with instructions issued by the surface movement controller (SMC). At the same time, a Cessna 310, registered VH-XXT (XXT), was holding at taxiway Echo 2 (E2) for an intersection departure from runway 29.

Darwin runway complex

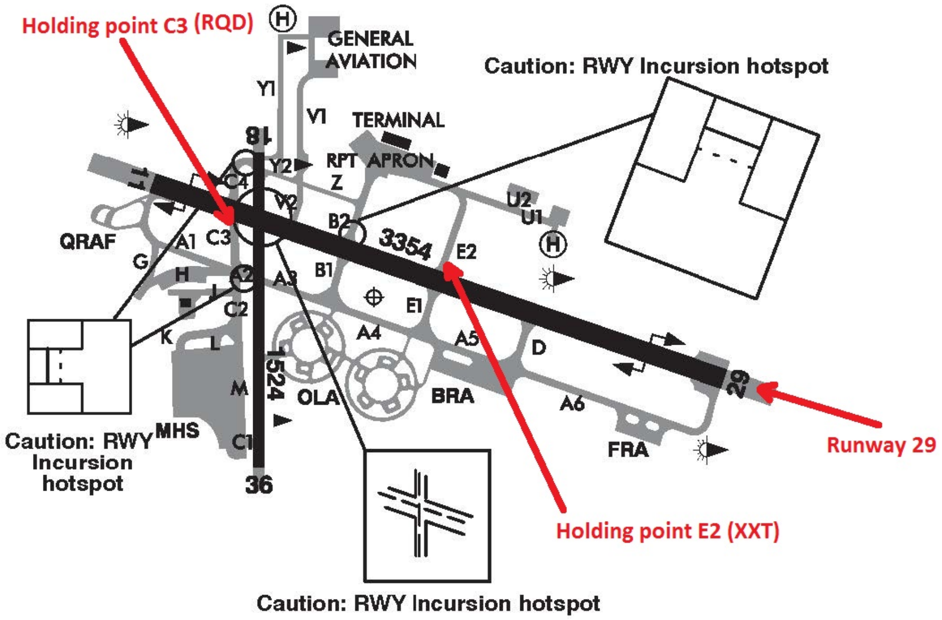


Source: Airservices Australia

- At 1319:00, the aerodrome controller (ADC) instructed XXT to line up on runway 29.
- At 1319:20, the SMC instructed RQD to cross runway 29 on taxiway Charlie and advised that "the aircraft lining up will be holding for you."
- At 1319:40, the ADC cleared XXT for takeoff on runway 29.

It was estimated both visually and by radar that XXT then overflew RQD crossing the runway by between 150 ft and 500 ft (Figure 2).

Figure 1: Darwin Airport



Source: Airservices Australia

[1] Central Standard Time (CST) was coordinated Universal Time (UTC) + 9.5 hours.

Airport information

The Department of Defence provides air traffic control services at the Darwin airport.[2]

The runways in use at the time of the incident were runway 29 and runway 18. Taxiways Charlie 1 (C1) and Charlie 2 (C2) were unavailable due to explosive ordinance loading on the military hardstand. This restriction required all landing aircraft on runway 18 to backtrack and vacate no earlier than taxiway Alpha. The extended unavailability of taxiways C1 and C2 was unusual and resulted in restrictions and coordination outside the experience of the controllers.

ADC flight progress strips

The ADC used flight progress strips[3] to document aircraft details and control instructions. Each flight progress strip represented one aircraft or a formation of aircraft. The ADC strip bay was designed to reflect the current and projected clearances applicable to the take-off and landing areas and to serve as a memory aid to the ADC. A red "runway occupied" strip was used to represent an obstruction or limitation to the issuing of a take-off or landing clearance. The positioning of aircraft flight progress strips and the red "runway occupied" strip within the strip bay was dictated by ATC procedure and represented the 'strip picture', to aid in maintaining a traffic picture regarding the disposition of traffic on the runway and in the vicinity of the airport.

Visual Check of the take-off path

Manual of Air Traffic Services (MATS) procedures required the ADC to perform a visual check of the take-off path prior to issuing a take-off clearance and again immediately before a takeoff commenced.

Figure 2: Approximate path VH-XXT and VH-RQD

Source: Google Earth

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[2] The Department of Defence – Royal Australian Air Force (RAAF) was the airspace administering authority responsible for the provision of air traffic control services at Darwin.

[3] Flight progress strips are paper strips in plastic holders typically 25 mm x 200 mm, coloured to reflect the type of traffic movement, displaying aircraft details including callsign, type and altitude.

Coordination

The SMC is responsible for the control and coordination of aircraft operating on the ground. Movement of aircraft on the runways is subject to coordination with, and approval of, the ADC. Consequently, when an aircraft is required to cross a runway in use, the SMC is required to seek prior approval from the ADC.

Aerodrome controller

The ADC recalled coordinating the runway crossing of RQD with the SMC and placing the red "runway occupied" strip into the strip bay.

Surface movement controller

The SMC recalled coordinating the crossing of RQD with the ADC and the ADC placing the "runway occupied" strip into the strip bay. However, the SMC did not recall hearing the ADC issue a take-off clearance to XXT.

Tower supervisor

The tower supervisor noted that, at the time of the incident, there was a large number of aircraft waiting to depart and he had moved from his normal position to be closer to the ADC to assist. However, at the time of the incident, the supervisor was speaking with another controller within the tower. The supervisor did recall hearing the runway crossing coordination between the SMC and the ADC, and did not hear the take-off clearance issued to XXT.

Controller information

The ADC obtained a Darwin ADC endorsement in August 2010. The controller commented during the Defence investigation that he felt "uncomfortable" on the day due to the unusual configuration of the aerodrome, with C1 and C2 not being available. Also, the ADC controller had recently asked the tower supervisor to assist him develop his ATC skills to a training officer standard. Consequently, the ADC was focused on expediting the departure of aircraft.

Defence Investigation

The Defence investigation concluded that the red "runway occupied" strip, representing the obstruction of the crossing RQD, was placed into the strip bay above the departing flight progress strip representing XXT instead of below the flight progress strip for XXT as required by the procedures. This led the ADC controller to have an incorrect 'strip picture' and to conclude that there was no obstruction on the runway at the time of issuing the take-off clearance to XXT.

The Defence investigation also concluded that it was unlikely that a visual check of the take-off path would have alerted the ADC to the crossing aircraft, as it was most likely that RQD commenced crossing a number of seconds after XXT had commenced the take-off roll.

Safety message

Runway incursions are recognised as an ongoing safety concern for the aviation industry and have been cited in numerous accidents world-wide. They can be the result of many different factors and involve pilots, controllers and vehicle drivers.

A joint paper published by EUROCONTROL and the United States Federal Aviation Administration in September 2010 recognised that the air traffic management system was critically dependent on the day-to-day performance of air traffic controllers, and that monitoring traffic was a critical and complex activity. This incident highlights the need for controllers to remain vigilant in monitoring and scanning the runway, both prior to, and after issuing take-off and runway crossing clearances to pilots. The EUROCONTROL and FAA paper is available at the following link:

EUROCONTROL – Human Performance and Safety

- http://www.eurocontrol.int/articles/safety-and-human-performance-library

General details

Occurrence details

Primary occurrence type:	Loss of separation	
Occurrence category:	Serious incident	
Location:	Darwin Airport	
	Latitude: S 12°24.35´	Longitude: E 130°52.40´

Cessna 310, VH-XXT

Manufacturer and model:	Cessna 310
Registration:	VH-XXT
Type of operation:	Charter
Damage:	None

Cessna 210, VH-RQD

Manufacturer and model:	Cessna 210
Registration:	VH-RQD
Type of operation:	Charter
Damage:	None

Engine failure involving Cirrus SR22, VH-WYH

What happened

WYH at the accident site

Source: Pilot

On 21 November 2012, at about 1055 Eastern Daylight-saving Time,[1] a Cirrus SR22 aircraft, registered VH-WYH (WYH), departed Emerald, Queensland for Dubbo, New South Wales, on a private flight conducted under the instrument flight rules. The pilot and one passenger were on board.

At about 1122, the oil pressure annunciator light illuminated. The pilot observed that the engine oil pressure on the oil pressure gauge[2] had dropped from the green arc to the yellow arc and was indicating about 30 pounds per square inch (psi). He also noted that the engine oil temperature and cylinder head temperature indications remained within the normal range. The pilot pushed the oil warning annunciator light and the light extinguished. He then referred to the pilot's operating handbook[3] which contained the following instructions:

> *If low oil pressure is accompanied by normal oil temperature, it is possible that the oil pressure sensor, gage, or relief valve is malfunctioning. In any case, land as soon as practical and determine cause.*

Over the next 25 minutes, the oil pressure indication dropped a further 4 psi. At this point, the pilot contacted the maintenance organisation to advise them of the situation and the pilot indicated that as a result of the conversation he would monitor the situation.

At about 1217, the pilot elected to descend from an indicated altitude of 7,000 ft to 5,000 ft to take advantage of a tail wind at 5,000 ft.

Over the next hour and 19 minutes, the oil pressure indication dropped a further 10 psi to 17 psi. At about 1307, the pilot contacted the maintenance organisation again to discuss the situation and determine if he should land and replenish the oil system, with the 2 L of spare oil located on the aircraft. The pilot indicated that as a result of the conversation he would continue to monitor the situation.

As the oil pressure continued to slowly drop, the pilot became increasingly concerned and, at 1351, contacted air traffic control, requesting to track via Gilgandra, New South Wales and stating that the engine oil pressure was gradually decreasing.

At about 1359, WYH overflew Gilgandra and continued on towards Dubbo, at which point the oil pressure gauge indicated about 12 psi. The approximate flight time remaining to Dubbo was 11 minutes. At 1401, the engine failed and the pilot could hear something rattling around in the engine cowling. The pilot turned the aircraft towards Gilgandra aerodrome and broadcast a mayday call, indicating that the engine had failed and he intended to land at Gilgandra aerodrome. The pilot then shut down the engine. It became evident that a landing at Gilgandra aerodrome was not achievable and he looked for a suitable landing point away from roads, trees and possible power lines. The pilot broadcast a call on the Melbourne Centre frequency advising that they

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1 Eastern Daylight-saving Time (EDT) was coordinated Universal Time (UCT) + 11 hours.

2 Oil Pressure gauge instrument markings contains a red line (warning) at 10 psi, a yellow arc (caution) between 10-30 psi, a green arc (normal) between 30-60 psi, another yellow arc (caution) between 60-100 psi and a red line (warning) at 100 psi.

3 Cirrus pilot's operating handbook (POH) part number 13772-001, Section 3 *Emergency Procedures Low Oil Pressure.*

would not be able to make Gilgandra aerodrome and would deploy the ballistic parachute[4]. The pilot reported that to minimise drift under the ballistic parachute, he waited until the indicated altitude was about 2,000 ft, before deploying the parachute.

At about 1405, the pilot deployed the ballistic parachute and broadcast a call on the Melbourne Centre frequency advising that the ballistic parachute had been deployed.

The pilot secured the cabin and about 16 seconds after the parachute deployed, the aircraft impacted the ground in a slight left wing low attitude (Figure 1). The pilot and passenger seat belt air bags deployed and the pilot and passenger exited through the passenger door. The pilot received minor injuries and the passenger was uninjured.

Figure 1: Parachute inflated at accident site

Source: Pilot

Pilot comments

The pilot reported that the oil pressure indication dropped very gradually giving a false sense of security. Three or four weeks prior to the accident, the engine turbocharger intake temperature thermostat probe had failed. As the engine cylinder head temperature and oil temperature indications remained in the normal range, accompanied by the recent turbocharger probe failure the pilot thought that the low oil pressure indication may have been another faulty probe.

The day before the accident, the aircraft flew about 3.7 flight hours that was the first flight after a 100 hourly maintenance check. As part of the pre-flight inspection for that flight, the pilot checked the engine oil level which indicated about 7 quarts[5] on the dipstick.

The pilot reported that when he conducted the pre-flight inspection on the day of the accident, the engine oil level indicated below 5 quarts and 1 L of oil was added to the engine. The pilot commented that it was unusual to add 1 L oil after conducting 3.7 flight hours. The oil level was

[4] The aircraft is equipped with a Cirrus Airplane Parachute System (CAPS) designed to bring the aircraft and its occupants to the ground in the event of a life threatening emergency. The system includes a parachute, a solid propellant rocket to deploy the parachute, a rocket activation system and a harness faired into the fuselage structure.

[5] One US quart is equivalent to about 0.95 L.

checked again and the level was between 5 and 5 ½ quarts, which the pilot indicated was the oil level he normally maintained.

The pilot reported that there was no evidence of oil coming from the engine breather, including after the 7.7 flight hours on the day of the accident.

Inspection at accident site

The pilot indicated that there was no sign of an external oil leak from the engine and there was no oil on the windscreen (Figure 2).

The pilot checked the oil level at the accident site and the engine oil dipstick indicated 2 quarts.

The pilot inspected the paddock after the accident and found that it was very uneven with contour banks that were not visible from the air. The pilot believed that a safe landing on the landing gear would not have been possible.

Figure 2: WYH at the accident site

Source: NSW Police Force

Engine examination

The engine was removed and examined at an engine overhaul facility. The inspection revealed that the number two cylinder connecting rod (Figure 3) had separated from the crankshaft due to extreme heat and ruptured the crankcase. A detailed examination did not identify any external oil leaks or internal defects that were not as a result of the lack of oil. 2.1 quarts of oil was drained from the engine sump.

Figure 3: Engine number two cylinder failed parts

Source: Insurance assessor

Engine oil system

The oil for engine lubrication is drawn from an eight quart capacity sump located in the engine crankcase. The oil provides engine lubrication and cooling. A filler cap with integral dipstick is provided for determining the amount of oil in the engine crankcase. The engine oil servicing section of the POH requires that if the engine oil level is below 6 quarts then the engine filler cap should be removed and oil added through the filler as required to reach between 6 and 8 quarts.

The POH also contains the following caution:

> *The engine should not be operated with less than six quarts of oil. Seven quarts (dipstick indication) is recommended for extended flights.*

The aircraft manufacturer indicated that maintaining an oil level above the minimum allows for that extra margin of safety, reliability, and dependability.

The aircraft engine is designed[6] to have an oil sump capacity of 8 quarts with 5 quarts usable at 16 degrees nose up and 4.5 quarts usable at 10 degrees nose down.

ATSB comment

The average oil consumption for the combined accident and previous flight was about 0.5 quarts per hour which is near the upper end of the maximum oil consumption[7] for the engine.

Safety message

This accident highlights the importance of understanding the information contained in the manufacturer's publications. The Cirrus pilot's operating handbook emergency procedure for low engine oil pressure requires that the pilot land as soon as practical and determine the reason for the low oil pressure indication, even if the oil pressure sensor, oil pressure gauge, or oil relief valve is suspected as the reason for the low oil pressure indication. The pilot's operating handbook also requires that the engine should not be operated with less than six quarts of oil and seven quarts is recommended for extended flights.

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6 Engine type certificate data sheet type certificate number E3SO.

7 Engine specifications IO-550-N www.tcmlink.com/EngSpecSheetDocs/IO550N.pdf.

Aeronautical decision making is a systematic approach to the mental process used by pilots to help determine the best course of action, in response to a given set of circumstances. Aeronautical decision making can be influenced by many factors such as the gradual onset of a risk, perceived severity of the risk, incomplete or misinformation and previous experience. The FAA *Pilot's handbook of aeronautical knowledge Chapter 17 Aeronautical decision making* contains various tools to aid in decision making, such as risk matrixes. The handbook is available at www.faa.gov/library/manuals/aviation/pilot_handbook/.

General details

Manufacturer and model:	Cirrus SR22	
Registration:	VH-WYH	
Type of operation:	Private	
Occurrence category:	Accident	
Primary occurrence type:	Total power loss/engine failure	
Location:	7 km S Gilgandra (ALA), New South Wales	
	Latitude: 31° 45.75' S	Longitude: 148° 37.27' E
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – 1 (Minor)	Passengers – Nil
Damage:	Substantial	

Loss of performance involving DH-82A (Tiger Moth), VH-DDA

What happened

Aircraft damage

Source: Flight crew

On 15 December 2012, after conducting a pre-flight briefing, four DH-82A (Tiger Moth) aircraft departed runway 12 at Luskintyre Airport, NSW, for a practice formation flight. The pilot flying VH-DDA (DDA), the formation lead aircraft, was seated in the rear and was under instruction from the front seat pilot. The aircraft was operating at 15 kg below the maximum all up weight of 827 kg.

At about 1830 Eastern Daylight-saving Time[32], full power was applied for take-off. The instructing pilot later reported that normally the power was then reduced to 2,150 revolutions per minute (RPM) for the climb out to allow the second aircraft in the formation to catch up. However neither pilot reported reducing the power on this occasion. Passing through about 50 ft above ground level, the pilot flying noted that the aircraft was not climbing as expected and so he applied full power by moving the throttle fully forward[33] and lowered the nose of the aircraft slightly to gain speed. Both pilots later reported that they confirmed that the throttle was fully forward.

As there was insufficient distance remaining to land on the runway, and it had become evident that a forced landing was imminent, the instructing pilot input a slight left bank so that the left wing of DDA took the main force of the impact. The aircraft landed and struck a tree before coming to rest (Figure 1). Both pilots were able to undo their four-point harnesses and exit the aircraft without assistance, although the pilot flying received serious facial injuries.

A small fire caused by a fractured fuel line was quickly extinguished by ground crew and the aircraft sustained substantial damage.

ATSB comment

While both pilots reported that they had not reduced engine power after take-off, the accident was a result of decreasing airspeed and the aircraft being unable to recover following the reapplication of full power. The ATSB could not resolve this ambiguity.

The positive aspects of wearing full restraint harnesses, evacuating the aircraft quickly and extinguishing the fire ensured neither pilot experienced further injuries.

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32 Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

33 As a Tiger Moth does not have an accelerator pump, when full power is applied after power has been retarded, the aircraft will take about 4 to 5 seconds to respond.

Figure 1: Damage to left wing following impact with a tree

Source: Aircraft owner

Safety Message

Comprehensive pre-flight briefings are important for all flights to ensure each crewmember is aware of their respective roles as well as normal and non-normal operations. Information on pre-flight briefings can be found in CASA CAAP 5.14-2 (0): Flight Instructor Training (Aeroplane) available at:
http://www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/5_14_2.pdf

Additional information on pre-flight briefings is also available at:
http://www.skybrary.aero/index.php/Flight_Preparation_and_Conducting_Effective_Briefings_(OGHFA_BN)

The following ATSB investigation reports provide further reading on DH-82 aircraft accidents:

- AO-2012-017 – Collision with terrain – De Havilland DH-82A aircraft, VH-GVA, Maryborough Airport, Victoria, 27 January 2012 is available at: www.atsb.gov.au/publications/investigation_reports/2012/aair/ao-2012-017.aspx
- AO-2011-005 – Collision with terrain – De Havilland, VH-WHW, SE 11 km Toowoomba Airport, Qld, 16 January 2011 is available at: http://www.atsb.gov.au/publications/investigation_reports/2011/aair/ao-2011-005.aspx

General details

Registration:	VH-DDA	
Manufacturer and model:	De Havilland Aircraft Pty Ltd DH-82A	
Type of operation:	Private	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	Luskintyre Airport, NSW	
	Latitude: 32°40.12' S	Longitude: 151°25.25' E
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 1 (Serious), 1 (Nil)	Passengers – 0
Damage:	Substantial	

Aircraft proximity event between an Alpha Aviation R2160, VH-NZT and a Diamond DA 40, VH-UNH

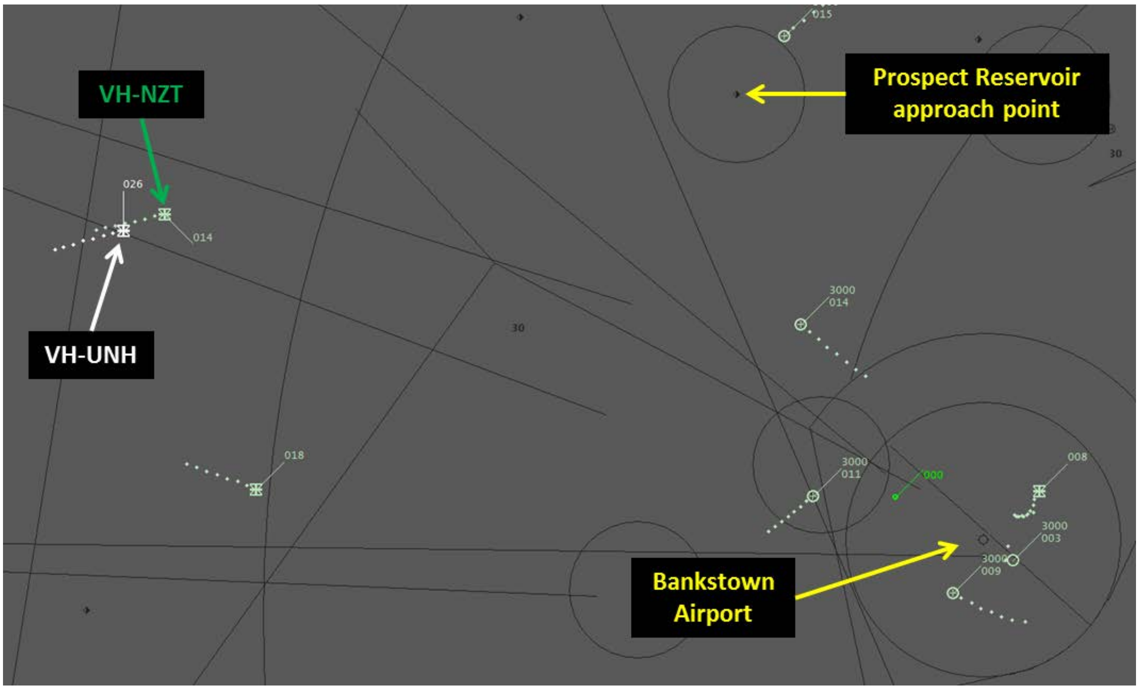
What happened

On 17 January 2013, the flight instructor and student pilot of an Alpha Aviation R2160 aircraft, registered VH-NZT (NZT), had completed a training flight in the local training area to the west of Bankstown, New South Wales. They were returning to Bankstown via the 'Prospect Reservoir' (Prospect) [1] visual flight rules (VFR) approach point, maintaining 1,500 ft. The Airservices Australia surveillance data showed NZT maintaining 1,400 ft. The pilot reported that the aircraft's altimeter was indicating 1,500 ft and that the transponder had since been corrected for the 100 ft discrepancy.

At the same time, the instructor and student of a Diamond DA 40 aircraft, registered VH-UNH (UNH), were also returning to Bankstown via Prospect after conducting flying training in the local training area. They had been operating between 2,500 and 3,500 ft and elected to conduct a shallow descent to arrive at Prospect maintaining 1,500 ft.

Airservices Australia surveillance data showed UNH following NZT on a similar track (Figure 1).

Figure 1: VH-NZT and VH-UNH tracking to Prospect Reservoir



Source: Underlying image sourced from Airservices Australia

Both UNH and NZT continued tracking for Prospect and when at 4-5 NM, the instructor of NZT changed radio frequency to Bankstown Tower. Shortly after, at 3.5 NM (1550:47 Eastern Daylight-saving Time[2]), UNH was observed on the Airservices Australia surveillance data descending overhead NZT with 600 ft recorded vertical separation, which was actually 500 ft, accounting for

[1] Prospect Reservoir reporting point is located at the north-eastern shore of the Reservoir, next to an open cut quarry.

[2] Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

NZT's transponder discrepancy (Figure 2). The pilot of NZT reported maintaining 1,500 ft while UNH continued to descend.

At 1551:19, the surveillance data showed that there was 0.2 NM lateral and 300 ft vertical separation (200 ft actual) between UNH and NZT (Figure 3). After that time, for undetermined reasons, the altitude readout for NZT on the Airservices Australia surveillance data was temporarily corrupted and not recorded.

Figure 2: Aircraft positions at 1550:47

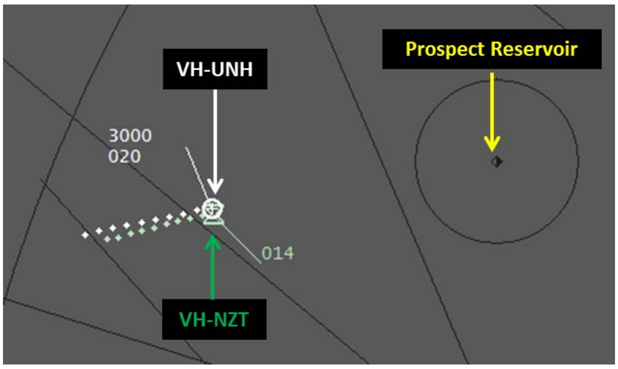
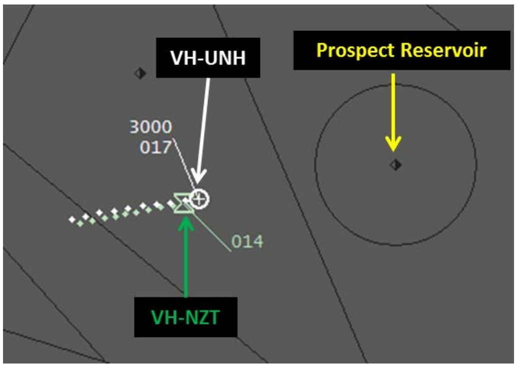


Figure 3: Aircraft positions at 1551:19



Source: Underlying image sourced from Airservices Australia

At 1551:37, when 2 NM from Prospect, the instructor of UNH changed to the Bankstown Tower frequency and heard a broadcast from NZT advising they were inbound from Prospect at 1,500 ft (Figure 4). At that time, UNH was also maintaining 1,500 ft. As the instructor and student were not aware of NZT, they immediately commenced looking for the aircraft.

At about the same time, NZT received circuit joining instructions from Bankstown Tower air traffic control (ATC). About 20-30 seconds later, the instructor reported sighting a 'flash' in his 10-11 o'clock[3] position and observed an aircraft (UNH) on descent, with about 30 m lateral separation. The instructor and student were not aware of UNH prior to that time.

Shortly after, the instructor contacted ATC advising that they nearly had a mid-air collision. Air traffic control replied that NZT was the only aircraft that had called at Prospect and the tower situational awareness display (TSAD)[4] showed two aircraft in that area, one to the north at 1,500 ft squawking Mode C[5] and a second not squawking Mode C. The instructor of UNH then observed NZT in his 3-4 o'clock position and appeared to be about 2 NM away and slightly lower.

NZT commenced the turn inbound to Bankstown (Figure 5). At the time of the incident, both NZT and UNH were operating in Class G airspace[6].

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3 The clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face. Twelve o'clock is ahead while an aircraft observed abeam to the left would be said to be at 9 o'clock.

4 TSAD: Surveillance data display, which assists Tower controllers to maintain situational awareness.

5 Mode C: An aircraft transponder signal with barometric information from an encoding altimeter, encrypted so that it enables altitude presentation on air traffic control radar screens.

6 Class G airspace is classified as non-controlled airspace. Instrument flight rules (IFR) and VFR flights do not require an airways clearance and ATC separation services are not provided.

Figure 4: Aircraft positions at 1551:37

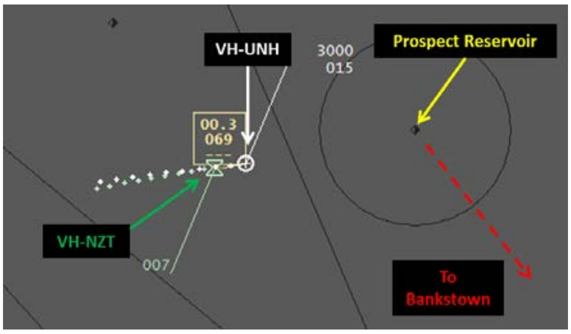
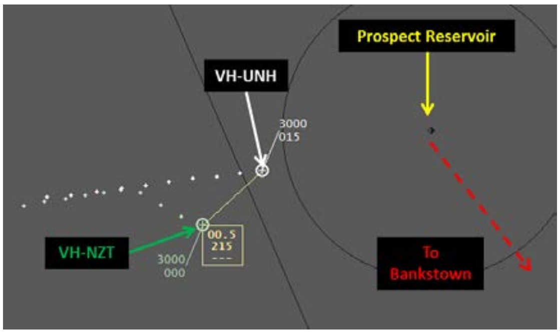


Figure 5: NZT turning inbound



Source: Underlying image sourced from Airservices Australia

At about 1552:39, the instructor of UNH broadcast his inbound call to Bankstown Tower and was advised by ATC of NZT ahead. The instructor replied that NZT was sighted. Both aircraft landed without further incident.

The instructor of UNH commented that NZT would have been obscured by the nose of the aircraft during the descent.

Safety message

All aircraft have blinds spots. Low-wing aircraft have blind spots below them that may obscure conflicting traffic when descending, while high-wing aircraft may block the view of the area you are turning into. Pilots should be aware of the visual restrictions of their aircraft and take the appropriate measures to clear the area around them, whether raising the wing of a high-wing aircraft to check for traffic prior to turning or making shallow S-turns when climbing or descending in any aircraft. This is particularly important when operating within the vicinity of high traffic density areas such as VFR approach points. While VFR approach points are not mandatory entry points into Class D[7] airspace, their use is recommended as they provide an orderly path for entering the circuit; assist with noise abatement; help keep aircraft out of nearby controlled airspace; and avoid the flow of outbound traffic. Consequently, when operating near VFR approach points, pilots need to remain vigilant and employ both alerted and unalerted see-and-avoid principles.

This incident highlights the importance of maintaining traffic clearance ahead and below, and for pilots to be mindful of aircraft blind spots.

The following publications and ATSB investigations provide information on collision avoidance and the human limitations of sighting aircraft:

- Collision avoidance strategies and tactics: www.aopa.org/asf/publications/sa15.pdf
- Collision avoidance – Methods to reduce the risk: https://easa.europa.eu/essi/egast/wp-content/uploads/2011/03/EGAST_Leaflet_Collision-Avoidance.pdf
- Mid-air collision - Cessna Aircraft 152, VH-FMG and Liberty Aerospace XL-2, VH-XLY, Casula NSW, 18 December 2008 www.atsb.gov.au/publications/investigation_reports/2008/aair/ao-2008-081.aspx
- Midair collision – Cessna Aircraft A150M, VH-UPY and Piper Aircraft PA-28-161, VH-CGT, 3 km NW of Moorabbin Airport, Vic, 27 August 2008 www.atsb.gov.au/publications/investigation_reports/2008/aair/ao-2008-059.aspx

[7] Class D: all aircraft must obtain an airways clearance and communicate with ATC. IFR aircraft are positively separated from other IFR aircraft and are provided with traffic information on all VFR aircraft. VFR aircraft are provided with traffic information on all other aircraft.

General details

Occurrence details

Primary occurrence type:	Aircraft proximity event	
Occurrence category:	Serious incident	
Location:	13 km NW of Bankstown Airport, New South Wales	
	Latitude: 33° 49.48' S	Longitude: 150° 54.92' E

Alpha Aviation R2160, VH-NZT

Manufacturer and model:	Alpha Aviation Design Ltd R2160	
Registration:	VH-NZT	
Type of operation:	Flying training - dual	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Diamond DA 40, VH-UNH

Manufacturer and model:	Diamond Aircraft Industries DA 40	
Registration:	VH-UNH	
Type of operation:	Flying training - dual	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Helicopters

Loss of control involving a Robinson R44, VH-RYO

What happened

Helicopter damage

Source: Helicopter operator

On 3 January 2013, a student pilot of a Robinson R44 (R44) Raven 1 helicopter fitted with fixed floats, registered VH-RYO (RYO), was conducting flying training at Moorabbin, Victoria.

The student had conducted a flight earlier in the day in RYO with a flight instructor and was preparing for a second flight, consisting of solo circuits and a short navigation exercise.

The student conducted his pre-start up checks and attempted to start the engine, without success. After realising that the rotor brake was still engaged, which electrically prevents engine start, he disengaged the brake and started the engine. This was the first time the student had conducted the start-up procedure in the R44 on his own. He then commenced his pre-takeoff checks.

The student signalled to the pilot of another helicopter also preparing to take off, to depart first. The other helicopter departed and the student prepared RYO to become airborne by increasing the engine revolutions per minute (RPM) to 100%. The student slowly raised the collective[1] and applied some left cyclic[2] and left yaw control pedal,[3] the helicopter became light on the skids, and started to slide and yaw to the left. The left skid then caught on the ground twice. The student became tense and immediately raised the collective. He reported that his subsequent movements of the controls were erratic. The helicopter pitched upwards and the tail boom contacted the ground. The helicopter rolled and came to rest on its right side.

The student exited the helicopter. Fuel was observed spilling from the helicopter, but no fire resulted. The student received minor injuries and the helicopter sustained serious damage (Figure 1).

The student reported that he had applied an excessive amount of left cyclic and left yaw control pedal to compensate for the absence of the instructor in the left seat. This resulted in the helicopter sliding and yawing to the left, and the left skid contacting the ground. In an attempt to avoid a dynamic rollover[4], the student inadvertently raised the collective, rather than lowering it to reject the takeoff. The student advised that he was aware of the correct procedure for reacting to an impending dynamic rollover, but for unknown reasons, he responded to the contrary.

A witness reported hearing the rotor RPM behaving erratically and observing the helicopter pitching and rolling. The tail boom contacted the ground several times and the helicopter then rotated around the tail and came to rest on its right side.

1 The collective pitch control, or collective, is a primary flight control used to make changes to the pitch angle of the main rotor blades. Collective input is the main control for vertical velocity.

2 The cyclic pitch control, or cyclic, is a primary flight control that allows the pilot to fly the helicopter in any direction of travel: forward, rearward, left, and right.

3 Yaw control or anti-torque pedals controls yaw about the yaw axis by controlling the pitch and therefore the thrust of the tail rotor blades or anti-torque system.

4 A dynamic rollover can occur whenever the landing gear (skid) contacts a fixed object, forcing the helicopter to pivot about the object instead of about its own centre of gravity. The fixed object can be any obstacle or surface that prevents the skid from moving sideways. Quickly reducing collective pitch is the most effective way to stop a dynamic rollover from developing.

Figure 1: Helicopter damage

Source: Helicopter operator

Pilot information

The pilot held a Student Pilots Licence, with about 64 hours total time, of which 5 hours were on the R44 and the remaining hours on the Hughes 300 helicopter. The pilot had a total of 1.2 hours solo time in the R44.

Helicopter information

The operator advised that RYO had not yet been retrofitted with bladder-type fuel tanks[5], but the rotor brake switch modification[6] had been completed, which reduced the chances of a possible ignition source in the event of a fuel leak.

Accident assistance

A bystander who attended the helicopter shortly after the accident elected not to assist the student with exiting due to the large fuel spillage and as the master electrical switch[7] was still turned on. The bystander commented that he did not want to expose more persons to a potentially dangerous situation. The aviation rescue and fire fighting personnel were called and no bystanders approached the helicopter until after the fuel spillage had been appropriately dealt with.

CASA independent investigation

The Civil Aviation Safety Authority (CASA) conducted an independent investigation, which found that the hydraulic switch was in the off position and the cyclic grip broken. It could not be conclusively determined if the hydraulics were turned off at the time of takeoff or if the switch was turned off as a result of the accident sequence.

Safety message

Aircraft fuels are a primary hazard that may contribute to a post-accident fire. If ignited they pose danger to survivors, rescue personnel, fire services personnel, etc[8]. This accident highlights the importance of considering all the potential hazards at an accident site before entering, and if there is any doubt, remain clear.

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5 Bladder-type fuel tanks improve the fuel system resistance to a post-accident fuel leak.

6 Robinson Helicopter Company R44 Service Bulletin SB-82 'Rotor Brake Switch' www.robinsonheli.com/service_library/r44_service_bulletins/r44_sb82.pdf

7 The master switch provided electrical power to the helicopter's systems.

8 www.atsb.gov.au/media/1538966/civil_militaryaccidguide_v5.pdf

General details

Registration:	VH-RYO	
Manufacturer and model:	Robinson Helicopter Company R44 Raven 1	
Type of operation:	Flying training - solo	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	Moorabbin Airport, Victoria	
	Latitude: 37° 58.55' S	Longitude: 145° 06.13' E
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – 1 (Minor)	Passengers – Nil
Damage:	Nil	

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau 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 safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

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.

About this Bulletin

The ATSB receives around 15,000 notifications of Aviation occurrences each year, 8,000 of which are accidents, serious incidents and incidents. It also receives a lesser number of similar occurrences in the Rail and Marine transport sectors. It is from the information provided in these notifications that the ATSB makes a decision on whether or not to investigate. While some further information is sought in some cases to assist in making those decisions, resource constraints dictate that a significant amount of professional judgement is needed to be exercised.

There are times when more detailed information about the circumstances of the occurrence allows the ATSB to make a more informed decision both about whether to investigate at all and, if so, what necessary resources are required (investigation level). In addition, further publically available information on accidents and serious incidents increases safety awareness in the industry and enables improved research activities and analysis of safety trends, leading to more targeted safety education.

The Short Investigation Team gathers additional factual information on aviation accidents and serious incidents (with the exception of 'high risk operations), and similar Rail and Marine occurrences, where the initial decision has been not to commence a 'full' (level 1 to 4) investigation.

The primary objective of the team is to undertake limited-scope, fact gathering investigations, which result in a short summary report. The summary report is a compilation of the information the ATSB has gathered, sourced from individuals or organisations involved in the occurrences, on the circumstances surrounding the occurrence and what safety action may have been taken or identified as a result of the occurrence.

These reports are released publically. In the aviation transport context, the reports are released periodically in a Bulletin format.

Conducting these Short investigations has a number of benefits:

- Publication of the circumstances surrounding a larger number of occurrences enables greater industry awareness of potential safety issues and possible safety action.
- The additional information gathered results in a richer source of information for research and statistical analysis purposes that can be used both by ATSB research staff as well as other stakeholders, including the portfolio agencies and research institutions.
- Reviewing the additional information serves as a screening process to allow decisions to be made about whether a full investigation is warranted. This addresses the issue of 'not knowing what we don't know' and ensures that the ATSB does not miss opportunities to identify safety issues and facilitate safety action.
- In cases where the initial decision was to conduct a full investigation, but which, after the preliminary evidence collection and review phase, later suggested that further resources are not warranted, the investigation may be finalised with a short factual report.
- It assists Australia to more fully comply with its obligations under ICAO Annex 13 to investigate all aviation accidents and serious incidents.
- Publicises ***Safety Messages*** aimed at improving awareness of issues and good safety practices to both the transport industries and the travelling public.

ATSB Transport Safety Report

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