Australian Government

Australian Transport Safety Bureau

Aviation Short Investigation Bulletin

Issue 23

Investigation

ATSB Transport Safety Report

Aviation Short Investigations

AB-2013-166

Final – 31 October 2013

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Abnormal engine indications involving a Boeing 747-438, VH-OJS

This investigation report was originally released in August 2012. This revision contains an update based on additional information from the outcomes of the engine manufacturer's internal investigation into the occurrence.

What happened

On 16 October 2011, at about 1033 Coordinated Universal Time (UTC)[1], a Boeing 747-438 aircraft, registered VH-OJS, operated by Qantas Airways, departed Suvarnabhumi Airport, Bangkok, Thailand on a scheduled passenger flight to Sydney, Australia.

About 8 minutes into the flight, as the aircraft was climbing through 13,000 ft, the crew reported hearing a loud bang and experiencing vibrations and abnormal indications from the No. 3 engine. Fumes were also reported in the cabin for several minutes after the event.

The flight crew shutdown the engine and broadcast a 'PAN'[2] before jettisoning approximately 55 tonnes of fuel and returning to Bangkok where the aircraft landed safely at 1147 UTC. The engine failure was fully contained and there were no reported injuries to passengers or crew.

Initial engine examination

Initial borescope inspection of the Rolls-Royce RB211-524G2-T engine, serial number 13748, was conducted by the aircraft operator before the engine was removed for disassembly and examination at an overhaul facility in Hong Kong.

The initial inspection showed that a single, stage 7 intermediate pressure compressor (IPC) blade had separated from its slot in the compressor disc (Figure 1). Disassembly of the engine confirmed the blade release and revealed significant damage to the remaining IPC blades as well as to the surrounding components.

There was evidence of a small, localised titanium fire that appeared to be the result of the released blade being jammed between the stage 7 IPC rotors and stators.

The released blade was destroyed as a result of its passage through the engine.

Engine history

The engine had undergone a full overhaul prior to being fitted to VH-OJS in August 2007 and had accrued 19,615 hours and 1,988 cycles since that time. There were no known issues with the engine.

Previous occurrences

The engine manufacturer advised that this was the first recorded stage 7 IPC blade release event in over 40 million hours of engine-type service and that there had only been two previous findings relating to stage 7 IPC blades.

In 2005, a stage 7, IPC blade was found to contain cracking in the blade root during a routine inspection after a planned engine removal, however the cause of the crack was not conclusively identified. In 2007, an engine was rejected due to a stage 7, IPC blade that was found displaced rearwards within the disc slot during a routine engine inspection.

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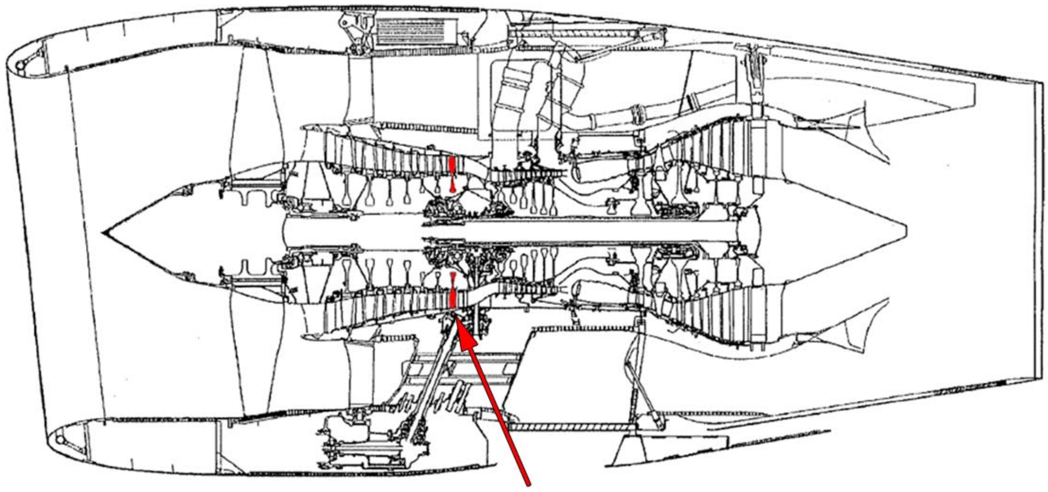
1 Coordinated Universal Time (UTC) is the time zone used for civil aviation. Local time zones around the world can be expressed as positive or negative offsets from UTC. Bangkok was UTC + 7 hours.

2 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.

Figure 1: RB211-524 engine with stage 7 IPC rotor highlighted



Source: Rolls-Royce

Rolls-Royce investigation

In May 2013, the Rolls-Royce completed a comprehensive and detailed investigation into the cause of the stage 7 IPC blade release. The investigation involved an examination of the remaining physical evidence, assembly trials, detailed modelling and stress analyses and a comparison with the 2005 occurrence of blade cracking.

The investigation concluded that the released stage 7, IPC blade had most probably been locked in place at an offset angle to the engine axis during assembly. The offset installation resulted in localised wear and significantly increased bedding stresses between the blade and disc. The increased stresses resulted in the initiation and propagation of a fatigue crack through the blade root until the blade was released under normal operational loads.

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.

Rolls-Royce

As a result of this occurrence, Rolls-Royce has advised the ATSB that they have introduced additional quality inspection checks to mitigate the risk of future events relating to misassembly during IPC blade installation.

General details

Occurrence details

Date and time:	16 October 2011 – 1041 UTC	
Occurrence category:	Incident	
Primary occurrence type:	Abnormal engine indications	
Location:	Near Suvarnabhumi Airport, Bangkok, Thailand	
	Latitude: 13° 10.73' N	Longitude: 100° 45.18' E

Aircraft details

Manufacturer and model:	The Boeing Company 747-438	
Registration:	VH-OJS	
Operator:	Qantas Airways Limited	
Serial number:	25564	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 18	Passengers – 358
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Minor	

Weather related event involving a Boeing 737, VH-YFF

What happened

On the evening of 28 January 2013, a Boeing 737 aircraft, registered VH-YFF, was being prepared for a scheduled passenger service from Canberra, Australian Capital Territory to the Gold Coast, Queensland. The captain was designated as the pilot flying.

The crew were aware of adverse weather conditions being experienced at the time in south-east Queensland, associated with ex-tropical cyclone Oswald, and had been monitoring the weather at the Gold Coast throughout the day.

Gold Coast Airport

Source: Google earth

In preparation for the flight, the crew assessed the weather forecast for the Gold Coast, which indicated strong winds, rain, and reduced visibility. Consequently, they selected Brisbane as an alternate airport and elected to carry additional fuel. The captain also contacted the duty operations controller to discuss the conditions and was advised that the weather had improved and that company aircraft had been landing. The aircraft subsequently departed Canberra at about 2151 Eastern Daylight-saving Time.[1]

Prior to commencing the descent into the Gold Coast, the crew listened to the automatic terminal information service (ATIS), which indicated reduced visibility, low cloud, and wind from 030° (Magnetic) at 30 kt. They also conducted an approach brief, which included a possible diversion to Brisbane due to the weather conditions at the Gold Coast.

During the descent, the crew changed to the Gold Coast Tower frequency early to obtain more information on the weather and were advised that the conditions were below the landing minima. The crew entered a holding pattern and continued to discuss the conditions with Gold Coast Tower air traffic control (ATC) and Brisbane Approach ATC. The crew were advised of two other company aircraft also in a holding pattern. The crew also asked Approach ATC if aircraft had been landing and were advised that they were the first aircraft to arrive for some hours. The crew had been of the prior understanding that aircraft had been arriving and departing.

About 15 minutes later, the crew were advised by ATC that the conditions had improved and were now above the landing minima. At about 2215 Eastern Standard Time,[2] the crew commenced the runway 32 area navigation global navigation satellite system (RNAV (GNSS)) approach into the Gold Coast. Due to the weather conditions, the crew configured the aircraft early for landing.

During the approach, the crew reported that they were in cloud and experiencing rain and a strong right crosswind of about 40-50 kt, resulting in a 15-20° drift angle.[3] The Tower controller advised the crew that the crosswind on the ground was 21 kt. The captain reported that he was mindful of the wind conditions and was prepared to initiate a go-around.

At about 1,000 ft above mean sea level (AMSL), the crew became visual with the runway. As the aircraft was on the desired approach path, the crew elected to continue the approach.

At about 300-400 ft AMSL, the captain disconnected the autopilot and manually flew the aircraft.

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

[2] Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

[3] Angle between heading (course) and track made good.

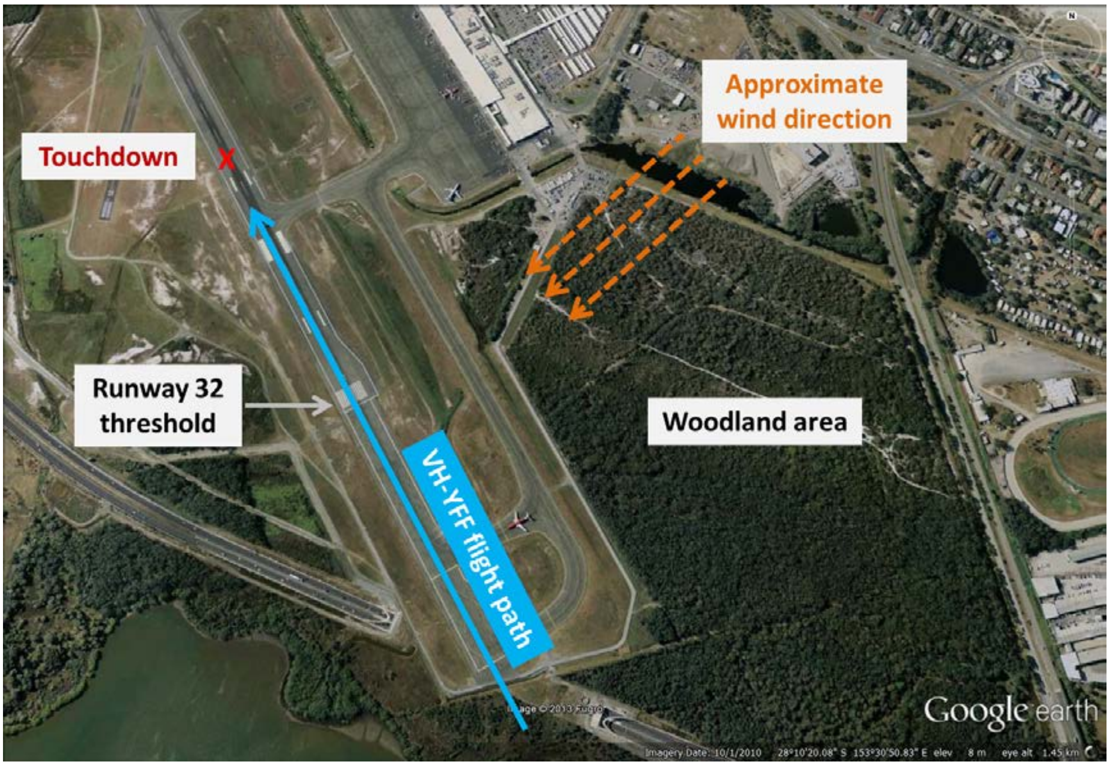
The captain stated that they were experiencing moderate turbulence and he was still prepared to commence a go-around; however, as the turbulence settled, the aircraft was aligned with the runway centreline, and the airspeed was stable, he again elected to continue with the landing.

At about 100 ft, the captain noted that the airspeed trend vector[4] was indicating a 20 kt decrease, likely the result of undershoot windshear.[5] The captain momentarily increased engine thrust to maintain the target approach speed.

During the landing flare, the captain applied left rudder and rolled the aircraft marginally to the right to align with the runway centreline. The aircraft floated briefly as a result of the additional engine thrust applied. The first officer (FO) stated that the aircraft drifted to the left of the centreline and the captain had to apply more control inputs to maintain runway alignment.

At about 2229, the aircraft touched down about 200 m further along the runway than intended (Figure 1). The autobrakes activated and the captain selected reverse thrust. The FO recalled the aircraft touched down on, or slightly right of the runway centreline. At that time, they were experiencing light rain.

Figure 1: Gold Coast Airport and VH-YFF touchdown location



Source: Google earth

After touchdown, the captain perceived that the aircraft was close to the left side of the runway, due to the proximity of the runway edge lights. The captain immediately applied right rudder, however, he inadvertently overcorrected, resulting in the aircraft veering to the right side of the runway. The captain applied left rudder and the runway centreline was regained. Shortly after, the captain overrode the autobrakes and commenced manual braking. The aircraft was slowed to taxi speed and taxied to the terminal.

While taxiing, the captain noted that there was a significant amount of standing water on the ground; however, there were no reports of standing water on the runway at that time.

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4 An arrow on the primary flight display (PFD), which indicates the predicted airspeed in the next 10 seconds based on the current airspeed and acceleration.

5 Windshear is a change in wind speed and/or direction. Undershoot windshear occurs when there is a reduction in the aircraft's airspeed from windshear, which results in the aircraft descending below the desired approach path.

The FO advised ATC that the wind during the flare was 'quite extreme with severe horizontal windshear'. Following aircraft were advised by ATC of the conditions.

Due to the weather conditions and high workload at the time, the captain was not certain if the aircraft was pointing towards the runway edge before touchdown or if the aircraft aquaplaned after touchdown. The FO reported that it felt like the aircraft aquaplaned and drifted to the left. However, after reviewing the flight data, the captain believed that the aircraft flared on centreline and drifted left before touchdown.

Meteorological information

Automatic terminal information service (ATIS)

The Gold Coast Airport ATIS information 'Tango', issued at 2141 on 28 January 2013, advised; surface conditions were wet, wind was 030° (Magnetic) with a minimum of 15 kt and maximum of 30 kt, maximum crosswind of 25 kt, visibility of 6 km and reduced to 2,000 m in passing rain showers, scattered cloud[6] at 600 ft and overcast cloud at 1,100 ft, and severe turbulence forecast below 5,000 ft.

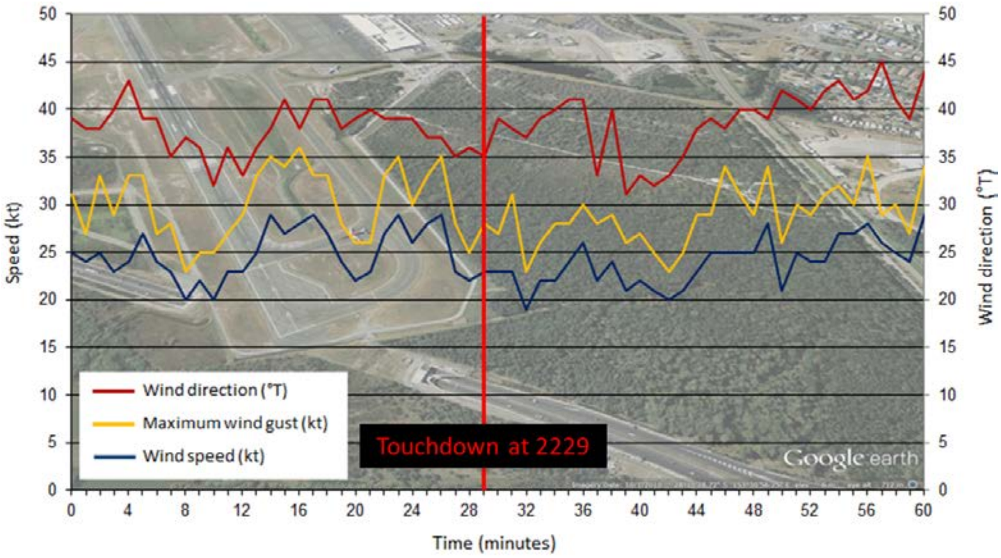
Aerodrome special weather reports (SPECI)[7]

The Bureau of Meteorology (BoM) automatic weather station (AWS) located at the Gold Coast generated aerodrome weather reports. The following SPECI reports were issued:

- At 2210: indicated that the wind was 040° (True) at 23 kt gusting to 33 kt; visibility was 1,600 m; broken cloud at 1,100 ft and overcast cloud at 1,600 ft; 1.0 mm of rain had fallen in the last 10 minutes and 52.2 mm had fallen since 0900.
- At 2230: indicated that the wind was 040° (True) at 25 kt gusting to 35 kt; visibility was 2,000 m; scattered cloud at 900 ft and overcast cloud at 1,400 ft; 0.6 mm of rain had fallen in the last 10 minutes and 53.4 mm had fallen since 0900.

The BoM subsequently provided the Australian Transport Safety Bureau (ATSB) with one-minute interval data recorded by the AWS. A graphical depiction of the wind speed (kt), maximum wind gust (kt) and wind direction (°True) between 2200 and 2300 is shown in Figure 2.

Figure 2: Bureau of Meteorology one-minute data



Source: Bureau of Meteorology

[6] Cloud cover is normally reported using expressions that denote the extent of the cover. The expression Few indicates up to a quarter of the sky was covered, Scattered indicates cloud was covering between a quarter and a half of the sky. Broken indicates that more than half to almost all the sky was covered, while Overcast means all the sky was covered.

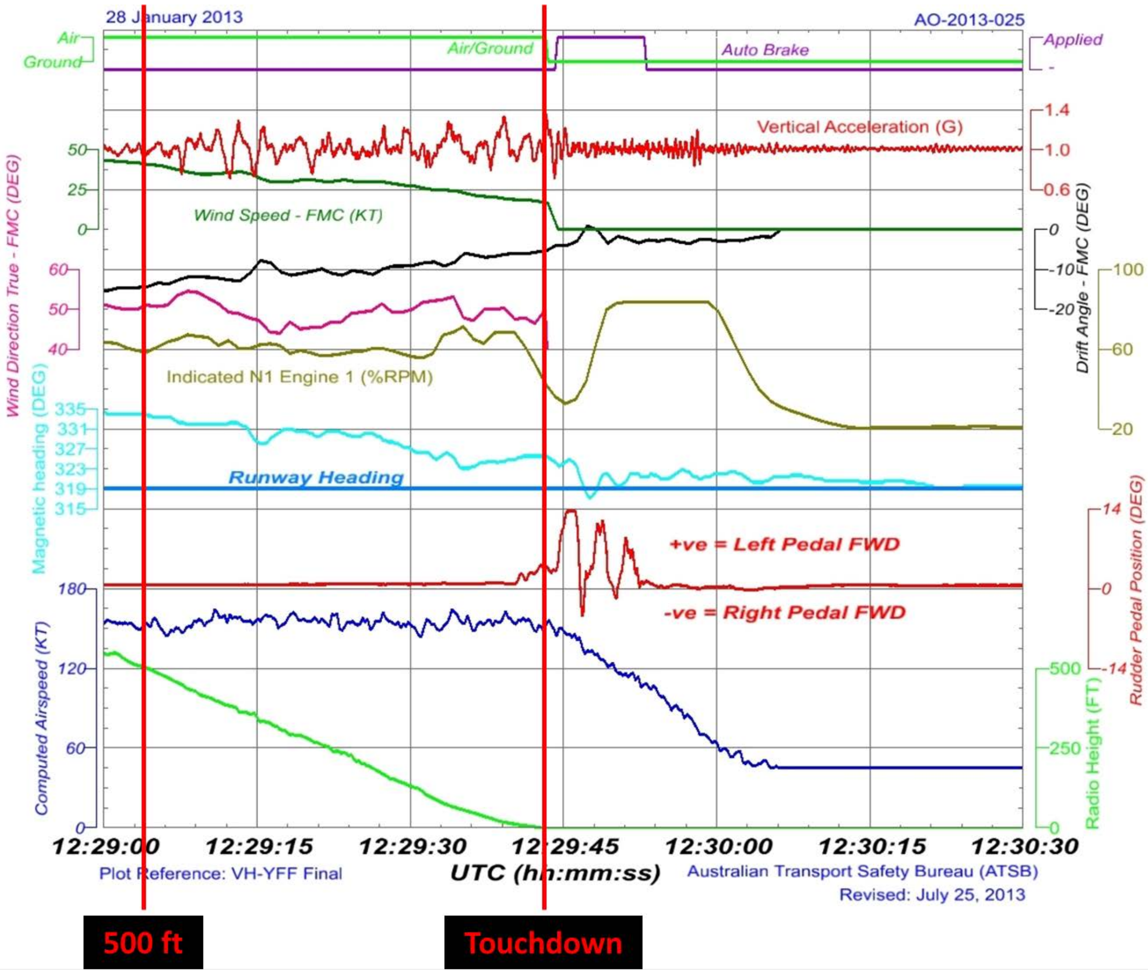
[7] A special weather report used to identify when conditions are below specified levels of visibility and cloud base; when certain weather phenomena are present; and when temperature, pressure or wind change by defined amounts.

Recorded information

The aircraft was fitted with a quick access recorder (QAR) and following the incident, the data was downloaded and provided to the ATSB.[8] The data showed the following (Figure 3):

- The wind speed and direction recorded by the aircraft's flight management computer was about 41 kt and 51° (True) at 500 ft, 25 kt and 52° (True) at 100 ft, and 17 kt and 50° (True) on the ground.
- The recorded values of the vertical acceleration showed that the aircraft experienced mild turbulence during the descent and at about 500 ft, this increased to moderate turbulence.
- At about 115 ft AMSL, engine thrust was increased.
- The autobrakes activated on touchdown and then about 8 seconds later, manual braking was commenced.
- Prior to landing, left rudder had been applied. This application was continued until several seconds after touchdown when right rudder was applied. Over the following 6 seconds, additional rudder movements were made to align the aircraft with the runway centreline.

Figure 3: Summary of flight data



Source: Australian Transport Safety Bureau

[8] The position of the aircraft on touchdown, relative to the runway centreline, could not be determined due to the inaccuracy of the data on the ground.

Pilot in command comments (captain)

The captain provided the following comments regarding the incident:

- The turbulence and undershoot windshear experienced prior to landing was due to the high ground and woodland area located to the east of the runway 32 threshold (Figure 1), which had the effect of reducing the aircraft's airspeed.
- Gold Coast Airport did not have trend forecast (TTF) capabilities, which would have been advantageous.
- He had concerns regarding the notification, receipt and distribution of critical meteorological information to crews regarding high crosswind conditions. The captain stated that it would have been useful to have had a more detailed discussion with the company prior to the commencement of the flight to determine if the weather conditions were in fact suitable for the operation. Also, in hindsight, he could have spoken to the company meteorologist, if available.
- He suggested that the company would benefit from obtaining feedback from crews that were operating into airports during marginal conditions.
- He believed that the crosswind during landing was greater than that advised by ATC.
- The incident occurred on the last sector of an 11-hour 17-minute day. The captain reported that he was starting to feel tired, however, he felt on top of things when they commenced the approach.
- If the aircraft had in fact veered to the left after touchdown, accumulated rubber on the touchdown zone from landing aircraft may have affected the sideways movement of the aircraft.

Trend forecast (TTF)

A TTF is an aerodrome weather report to which a statement of trend, for the elements wind, visibility, weather and clouds, is appended, forecasting the conditions expected to affect the aerodrome for the validity period of the TTF, which is normally 3 hours. The TTF supersedes the aerodrome forecast (TAF) for its validity period. The BoM advised the ATSB that the airline industry determines whether an airport receives a TTF service. At present, a TTF service can only be provided by the BoM if it is supported through manual observations by qualified observers at the airport. There are currently no qualified observers based at the Gold Coast Airport.

Gold Coast Tower wind information

Wind was displayed to both the Tower and Surface Movement Controller positions, which included the mean wind, crosswind, and headwind/tailwind components. This information was fed from the BoM AWS, which was located on the western side of runway 14/32, about midfield.

Gold Coast Airport runway information

The Gold Coast Airport advised the ATSB that runway 14/32 had a grooved asphalt surface. The runway grooves were visually inspected annually, with the last check conducted in mid-January 2013 and the results reported as 'good'. Surface friction inspections were also conducted every 6 months, with the last inspection performed in August 2012. The results indicated that the runway met, and exceeded the Civil Aviation Safety Authority (CASA) and International Civil Aviation Organization's (ICAO) requirements. Rubber removal was conducted on an as-needed basis, with the last removal performed in July 2012.

Virgin Australia investigation

The aircraft operator conducted an internal investigation into the incident and determined the following:

- **Following company aircraft:** The captains of the two following aircraft reported that the conditions on the night were the worst they had flown in during their time with the company. Both captains advised they were prepared to go-around and divert to Brisbane if required. One captain had to conduct a go-around, but landed successfully on the second attempt. The captain who landed on the first attempt queried the accuracy of the wind readings in the tower.
- **Inflight weather information:** Crews can request weather information from the company via the aircraft communications addressing and reporting system (ACARS), provided the crew had been appropriately trained in the use of the system.
- **Suspension of flights:** The weather experienced on the east coast had a significant impact on scheduled flights. Earlier in the day, two company aircraft operating to the Gold Coast had diverted and subsequent flights were suspended until mid-afternoon. The incident flight was the first company flight into the Gold Coast after the suspension.
- **Woodland area:** The woodland area located near the runway 32 threshold can affect the flow of wind when a strong right crosswind exists.

Safety message

Through its SafetyWatch initiative, the ATSB is highlighting an increasing trend in problems with aircraft handling and flight profile when unexpected events arise during the approach to land. When compared to other phases of flight, the approach and landing has a substantially increased workload. Further details are available at www.atsb.gov.au/safetywatch/handling-approach-to-land.aspx.

General details

Occurrence details

Date and time:	28 January 2013 – 2229 EDT	
Occurrence category:	Incident	
Primary occurrence type:	Weather related event	
Location:	Gold Coast Airport, Queensland	
	Latitude: 28° 09.87' S	Longitude: 153° 30.28' E

Aircraft details

Manufacturer and model:	The Boeing Company 737-8FE	
Registration:	VH-YFF	
Operator:	Virgin Australia Airlines	
Serial number:	40994	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 6	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Departure from an incorrect intersection involving an Embraer ERJ 190, VH-ZPC

What happened

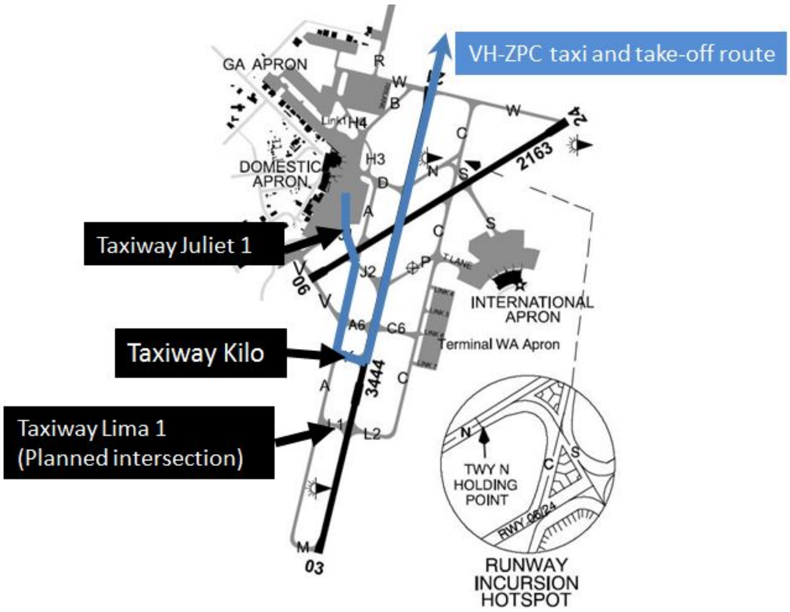
On 21 June 2013, the crew of an Embraer ERJ 190 aircraft operated by Virgin Australia, registered VH-ZPC (ZPC), conducted a scheduled passenger flight from Perth to Broome, Western Australia. The first officer (FO) was designated as the pilot flying and the captain was the pilot monitoring. During the pre-flight checks, the crew discussed which runway they would use for the take-off. As the aircraft was heavily loaded, the FO advised the captain that the aircraft was within 1 tonne of the maximum take-off weight for the runway currently in use at Perth, runway 06, and asked whether they should plan to use the longer runway, runway 03.

The FO recalled the captain responding that they should use runway 03 and use ‘Kilo’ intersection ‘to make it worthwhile’. This placed the thought in the FO’s mind that the take-off distance from intersection ‘Kilo’ was greater than from ‘Lima’ (Figure 1). As there were no take-off figures in the manual for ‘Kilo’, the FO entered the data for a departure from the intersection of taxiway ‘Lima’ on runway 03, into the flight management system (FMS). The FO was then under the impression that the take-off distance from ‘Kilo’ was greater than from ‘Lima’ and the figures entered would have included a buffer for a take-off from anything longer than intersection ‘Lima’.

The take-off briefing conducted prior to pushback included that figures were used allowing a take-off from intersection ‘Lima’ or longer.

The FO requested a taxi clearance to the taxiway ‘Kilo’ intersection of runway 03, and that clearance was given by air traffic control (ATC). The crew did not recall performing the usual taxi route briefing at that time. The captain then taxied the aircraft as per the ATC clearance, across runway 06 via taxiway ‘Juliet 1’, then via taxiway ‘Alpha’ to ‘Kilo’ from where they were cleared to take off on runway 03 (Figure 1). The FO conducted the standard take-off review, which included checking that the departure runway was correct, but did not have a requirement to verify the intersection.

Figure 1: Perth Airport



Source: Airservices Australia

During the take-off run, the aircraft was approaching V_1[1] when the captain thought that something did not appear correct. He considered applying maximum thrust, but decided that the aircraft was accelerating normally and left the thrust setting as it was. Once airborne and the aircraft was set up for the cruise, the captain and the FO discussed the situation. The captain initially thought that incorrect data had been entered into the FMS, but on looking at the take-off and landing data (TOLD)[2] card, he immediately saw that the planned departure was from the intersection of taxiway 'Lima' but they had inadvertently departed from the 'Kilo' intersection.

There was no performance data in the operations manual for a 'Kilo' departure. The captain stated that, if they had been required to reject the take-off, they may not have been able to stop on the remaining runway. Subsequent calculations by the operator found that the aircraft was below the maximum take-off weight for a departure from 'Kilo' and that the take-off distance required was sufficient.

The FO had previously operated other aircraft from Perth, frequently departing from the 'Kilo' intersection.

Flight crew comments

The captain believed that having mentioned intersection 'Kilo', it was then in the minds of both flight crew members.

The captain reported that there were lots of things that could have alerted them to the error. They had not completed the standard taxi route review on that flight and he thought that if they had, they may have picked up the error at that stage.

There is a taxiway opposite the runway intersection at 'Lima' but not at 'Kilo' and sighting this may have alerted them to being at an incorrect intersection. The captain reported that he now includes the intersection departure in the standard take-off review.

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, the aircraft operator has advised the ATSB that they are taking the following safety actions:

- The data for the 'Kilo' intersection departure at Perth will be included in the operator's manual for the Embraer ERJ 190.
- An article highlighting the possibility of incorrect intersections will be presented in the next safety publication to be distributed to all crew.
- The need to check the departure intersection will be highlighted during a briefing to check and training captains.

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1 V_1 is the critical engine failure speed or decision speed. Engine failure below this speed shall result in a rejected take-off; above this speed the take-off run should be continued.

2 Take-off and landing data, kept handy in the cockpit.

Safety message

The ATSB SafetyWatch campaign has identified the under-reporting of occurrences as one focus area of its investigations. Mistakes such as the one described in this incident, where no consequences occur, often go unreported. The ATSB commends the flight crew and operator for reporting this occurrence, which allowed the lessons of the occurrence to be shared with others.

General details

Occurrence details

Date and time:	21 June 2013 – 1650 WST	
Occurrence category:	Incident	
Primary occurrence type:	Pre-flight/planning event	
Location:	Perth Airport, Western Australia	
	Latitude: 31° 56.42' S	Longitude: 115° 58.02' E

Aircraft details

Manufacturer and model:	Embraer-Empresa Brasileira de Aeronautica ERJ 190-100 IGW	
Registration:	VH-ZPC	
Operator:	Virgin Australia	
Serial number:	19000170	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 5	Passengers – 65
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Two turbulence events involving a Boeing 737, VH-VZY and a Bombardier DHC-8-402, VH-QOP

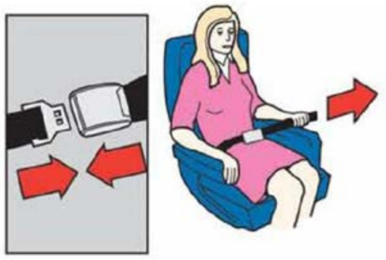
What happened

The ATSB was advised of two turbulence related events that occurred on 5 July 2013 and 7 July 2013, involving VH-VZY and VH-QOP respectively.

VH-VZY

On 5 July 2013, a Qantas Boeing 737 aircraft, registered VH-VZY, departed Perth, Western Australia on a scheduled passenger service to Canberra, Australian Capital Territory.

Keep your seat belt fastened



Source: ATSB

At about 2139 Eastern Standard Time,[1] while descending through 8,000 ft, the aircraft encountered severe turbulence for about 2 minutes. The flight crew reported that they experienced difficulties with maintaining their assigned altitude of 7,500 ft for about 1 minute and the aircraft descended to 7,200 ft. The flight crew made a passenger announcement over the public address system and turned the seat belt sign on. They also advised air traffic control (ATC) of the turbulence and subsequent altitude excursion.

A cabin crew member positioned in the rear of the aircraft sustained minor injuries. The flight continued without further incident.

VH-QOP

On 7 July 2013, a Sunstate Airlines Bombardier DHC-8-402 aircraft, registered VH-QOP, was being operated on a scheduled passenger service from Wagga Wagga to Sydney, New South Wales. The first officer (FO) was designated as the pilot flying.

During the cruise, while in clear conditions, maintaining flight level (FL)[2] 210, the aircraft experienced severe turbulence. The turbulence ceased for about 2 seconds and moderate turbulence was then experienced. The aircraft pitched upwards by 5°, the right wing dropped by 7°, and the airspeed increased by about 20 kt. In response, the captain reduced engine power, the autopilot was disconnected and the aircraft was manually flown by the FO. The seat belt sign was turned on. Once the aircraft's airspeed reduced, the autopilot was re-engaged. Overall, the turbulence encounter lasted for about 6 seconds.

In response to the turbulence, the two cabin crew members positioned at the rear of the aircraft immediately sat down. The cabin crew noted that a passenger, who had been standing, was injured. The captain contacted the cabin crew and was advised of the injured passenger. The captain made a passenger announcement and the seat belt sign was turned off to allow the cabin crew to assist the passenger. The FO advised ATC that they had experienced turbulence.

During the descent into Sydney, the cabin crew further advised the flight crew that the passenger appeared to have sustained a broken or dislocated ankle. About 10 minutes after the event, one of the cabin crew members reported also having sustained an ankle injury. After securing the cabin for landing, the injured cabin crew member was unable to continue duties. The flight crew were advised accordingly and the aircraft landed without further incident.

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

2 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 210 equates to 21,000 ft.

Safety message

Turbulence is a weather phenomenon responsible for the abrupt sideways and vertical jolts that passengers often experience during flights, and is the leading cause of in-flight injuries to passengers and cabin crew.

Research conducted by the ATSB[3] identified that 99 per cent of people receive no injuries during a typical turbulence event. However, passengers and cabin crew not wearing a seat belt can be thrown around without warning. Between January 1998 and May 2008, 339 turbulence events were reported to the ATSB by the airlines, which resulted in over 150 minor and serious injuries. Almost all in-flight turbulence injuries can be avoided by:

- Putting your seatbelt on and keeping it fastened when you are seated.
- Paying attention to the safety demonstration and any instructions given by the cabin crew.
- Reading the safety information card in your seat pocket.

General details

Boeing 737, VH-VZY

Date and time:	5 July 2013 – 2139 EST	
Occurrence category:	Incident	
Primary occurrence type:	Turbulence	
Location:	near Canberra Airport, Australian Capital Territory	
	Latitude: 35° 18.42' S	Longitude: 149° 11.70' E
Manufacturer and model:	The Boeing Company 737-838	
Registration:	VH-VZY	
Operator:	Qantas Airways Limited	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 7	Passengers – 162
Injuries:	Crew – 1 (Minor)	Passengers – Nil
Damage:	Nil	

Bombardier DHC-8-402, VH-QOP

Date and time:	7 July 2013 – 0950 EST	
Occurrence category:	Incident	
Primary occurrence type:	Turbulence	
Location:	191 km east-north-east of Wagga Wagga Airport, New South Wales	
	Latitude: 34° 36.55’ S	Longitude: 149° 26.47’ E
Manufacturer and model:	Bombardier DHC-8-402	
Registration:	VH-QOP	
Operator:	Sunstate Airlines	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 4	Passengers – 44
Injuries:	Crew – 1 (Minor)	Passengers – 1 (Minor)
Damage:	Nil	

[3] *Staying Safe against In-flight Turbulence:* www.atsb.gov.au/publications/2008/ar2008034.aspx

Loss of separation between an Airbus A320, VH-VFJ and a Bell 412, VH-VAO

What happened

Runway 36 VOR approach

Source: Airservices Australia

On the evening of 4 July 2013, a Jetstar Airways Airbus A320 aircraft, registered VH-VFJ (VFJ), was conducting a very high frequency omnidirectional radio range (VOR)[1] approach to runway 36 at Avalon Airport, Victoria, under instrument flight rules (IFR).

At 2033 Eastern Standard Time,[2] as the pilot in command (PIC) of VFJ commenced the outbound leg of the approach, the pilot of a Bell 412 helicopter, registered VH-VAO (VAO), taxied at Avalon for an IFR flight to Warrnambool, Victoria.

As the air traffic control tower at Avalon was closed, the airspace immediately above Avalon to a height of 700 ft and within 8 NM was classified as Class G.[3] From 700 ft to 4,500 ft the airspace was Class E,[4] and above that was Class C.[5] Air traffic services were being provided to aircraft in Classes E and G by Avalon Approach air traffic control (ATC) and air traffic services for aircraft in Class C were being provided by Melbourne Departures ATC. At the time of the incident, the same controller was responsible for both Avalon Approach and Melbourne Departures. Aircraft operating in Class G were required to make broadcasts on the common traffic advisory frequency (CTAF). Due to the airspace configuration, pilots of IFR aircraft operating into and out of Avalon were required to monitor both the Avalon CTAF and the Avalon Approach frequency. In addition, IFR aircraft departing Avalon required a tracking clearance from Avalon Approach, but Avalon Approach did not provide a take-off clearance.

When the pilot of VAO had advised ATC he was taxying, the controller requested the pilot expedite so that VAO could depart before VFJ landed. At 2035, after making all the necessary broadcasts on the CTAF and receiving a clearance from the controller to enter Class E, VAO became airborne on a northerly heading on climb to 4,000 ft. However, due to a very strong westerly wind,[6] VAO's speed and climb rate were reduced. At about the same time, VFJ was about 9 NM south of Avalon turning inbound on the VOR approach.

The controller also advised the crew of VFJ that a helicopter, VAO, had become airborne, although it was likely the crew did not hear the full transmission as it coincided with VAO's departure broadcast on the CTAF. When the crew of VFJ did not respond to the call, the controller again advised of the traffic at Avalon, again receiving no response.

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1 VOR – A ground-based navigation aid that emits a signal that can be received by appropriately-equipped aircraft and represented as the aircraft's bearing (called a 'radial') to or from that aid.

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

3 Class G – IFR and VFR flights are permitted and do not require an airways clearance. IFR flights must communicate with air traffic control and receive traffic information on other IFR flights and a flight information service. VFR flights receive a flight information service if requested.

4 Class E – IFR aircraft require an airways clearance and must communicate with air traffic control. IFR aircraft are positively separated from other IFR aircraft and given traffic information on known VFR aircraft. VFR aircraft do not require an airways clearance and are not required to communicate with air traffic control.

5 Class C – All aircraft must get an airways clearance and communicate with air traffic control. IFR aircraft are positively separated from both IFR and VFR aircraft. Visual Flight Rules (VFR) aircraft are provided traffic information on other VFR aircraft.

6 The wind was reported as about 310˚ at 35 to 50 knots.

At 2038, as the helicopter climbed through 1,900 ft, about 2 NM north of Avalon, the controller instructed the pilot of VAO to turn left onto a heading of 260˚. Due to the strong westerly wind, the helicopter's track was almost northerly.

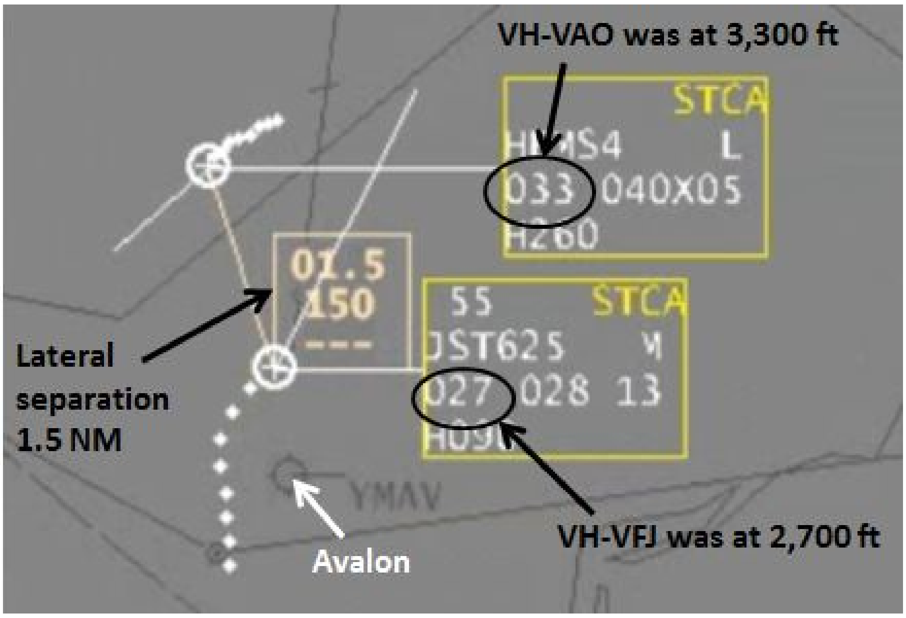
At 2039, the PIC of VFJ initiated a missed approach about 2 NM south of Avalon at 600 ft as the aircraft had become high on the descent profile, which would have resulted in an unstable approach. At that time, VAO had crossed the extended centreline of runway 36 about 2 NM north of Avalon passing 2,500 ft. The lateral separation between VAO and VFJ was 4.4 NM.

The missed approach procedure for the runway 36 VOR approach at Avalon required the PIC of VFJ to track north on climb to 3,000 ft. At 2039, as the required separation of 3 NM or 1,000 ft was about to be lost, the controller twice instructed the crew of VFJ to stop their climb but received no response.

A review of the relevant audio recordings showed that, 2 seconds after the controller's second transmission, the crew of VFJ responded, but on the CTAF, not on the Avalon Approach frequency. Ten seconds after the controller's second transmission, the crew of VFJ responded on the correct frequency, stating that they were unable to comply with an instruction to maintain 2,000 ft, but that they would maintain 2,500 ft. At that time, VAO was slightly west of the extended centreline of runway 36 passing 3,000 ft, still about 2 NM north of Avalon. Radar separation had reduced to 2.7 NM and the Short Term Conflict Alert (STCA) had activated on the controller's display.

The controller then instructed the crew of VFJ to make an immediate right turn and advised them of the location of VAO, 500 ft above and 2.3 NM ahead. As VFJ turned right, vertical separation reduced to 600 ft and lateral separation to 1.5 NM (Figure 1). The crew of VFJ continued the right turn and subsequently landed at Avalon without further incident. The pilot of VAO continued tracking west for his destination.

Figure 1: The positions of VH-VAO and VH-VFJ at 2040



Source: Airservices Australia

Avalon Approach controller comments

At the time of the incident, the controller was also responsible for airspace in relation to arrivals and departures into Melbourne Airport, requiring the controller to operate on two frequencies – Avalon Approach and Melbourne Departures. The controller had no facility to monitor the Avalon CTAF.

Shortly after clearing VAO to depart, the controller realised this compromised the missed approach path for VFJ. As soon as they became aware that the PIC of VFJ had initiated a missed approach, the controller gave tracking and level instructions to the crew of VFJ to re-establish the required separation. The controller also passed traffic on the helicopter.

The controller had completed annual compromised separation training the week prior to the incident, but reported that the training was based on generic airspace and, as the controllers undertaking the training were aware of what was about to happen in each of the training scenarios, it was not realistic. The controller reported that the training did not transfer to day-to-day operations; on the day of the incident the compromised separation was unexpected and the PIC of VFJ did not respond to his first two transmissions.[7]

Factual information provided by Airservices Australia

Airservices Australia (Airservices), the air navigation service provider for Avalon airspace, reported that, due to the proximity of the runway 36 VOR approach minima (600 ft) with Class G airspace (surface to 700 ft), aircraft are required to be given a clearance to re-enter Class E airspace with their arrival clearance. Such a clearance had not been provided to the crew of VFJ.

Further, Airservices stated that the controller had incorrectly planned and projected the traffic situation whereby there was no separation assurance between the helicopter's departure track and the aircraft's missed approach path.

Jetstar Airways investigation

An internal investigation conducted by Jetstar Airways found that the missed approach was the result of an unstable approach, partly caused by the strong westerly wind. Additionally, the investigation found:

- The initial CTAF broadcast from the pilot of VAO was indistinct and the crew of VFJ did not realise it was a helicopter.
- The instructions from the controller immediately following the initiation of the missed approach occurred during a time of high workload.
- Having left Class E airspace on the runway 36 VOR approach, the CTAF had been selected on the aircraft's radio, though the crew were still monitoring Avalon Approach. During a period of high workload, recognising the need to re-select the Avalon Approach frequency and then selecting it took about 15 seconds.
- The aircraft performance would have precluded the crew of VFJ from complying with the first two instructions from the controller.
- Though fitted with a traffic collision avoidance system (TCAS),[8] no alert was received.

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.

Jetstar Airways

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

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7 Airservices Australian advised the ATSB that there was no evidence to suggest that the Controller did not respond appropriately to the compromised separation event or the training provided to the controller was deficient or otherwise contributed to the occurrence.

8 TCAS is an aircraft collision avoidance system. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder and gives warning of possible collision risks.

Technical Newsletter

A technical newsletter will be sent to company flight crew highlighting the incident and:

- emphasising the joint responsibility for maintaining separation assurance
- providing guidance with regard to correct controller/crew interactions, specifically in relation to a clearance to leave and re-enter controlled airspace in the event of a missed approach at CTAFs with low overlying controlled airspace
- providing guidance with regard to controller expectation of the transfer of responsibility for separation from within the CTAF (on approach) to controlled airspace (in the event of a missed approach).

Airservices Australia

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

Avalon operations and airspace design

Airservices is currently undertaking a review of the risk profile associated with Avalon operations and airspace design. Of concern are the small layers of differing airspace classes with different service levels and frequency requirements. Pending the findings of the review, Airservices may request that the Civil Aviation Safety Authority (CASA) conduct an aeronautical study of the airspace surrounding Avalon Airport.

Safety message

This incident demonstrates that, while expediting traffic is an important objective for a controller, safety must always be the first consideration. In attempting to facilitate the helicopter's departure, the controller unintentionally placed it in the missed approach path of the aircraft. The strong westerly wind compounded the situation by slowing the helicopter and negating the effect of its westerly heading.

The incident also highlights the joint separation and communication responsibilities between crews and controllers in the Avalon airspace. When Avalon Tower is not active, the Avalon airspace is made up of Class G from surface to 700ft, then Class E. High performance IFR aircraft cannot remain in Class G airspace at Avalon while seeking a clearance to enter Class E.

General details

Occurrence details

Date and time:	4 July 2013 – 2040 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Loss of separation	
Location:	Avalon Airport, Victoria	
	Latitude: 38° 02.37' S	Longitude: 144° 28.17' E

Aircraft details: VH-VFJ

Manufacturer and model:	Airbus Industrie A320-232	
Registration:	VH-VFJ	
Operator:	Jetstar Airways Pty Ltd	
Serial number:	5311	
Type of operation:	Air transport - high capacity	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Aircraft details: VH-VAO

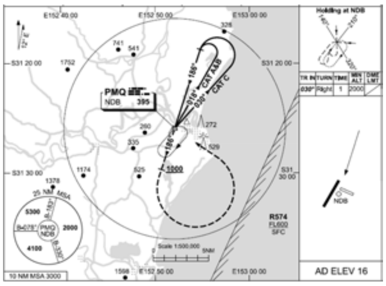
Manufacturer and model:	Bell Helicopter Company 412EP	
Registration:	VH-VAO	
Serial number:	36507	
Type of operation:	Aerial work	
Persons on board:	Crew – 3	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Turboprop aircraft

TCAS event between an ATR72, VH-FVH and a Bombardier DHC-8-315, VH-TQZ

What happened

Port Macquarie NDB approach



Source: Airservices Australia

On 12 February 2013, a Skywest Airlines ATR72 aircraft, registered VH-FVH (FVH), departed Sydney on a scheduled passenger service to Port Macquarie, New South Wales, under the instrument flight rules (IFR). The crew consisted of the captain, who was being checked to-line and was designated as the pilot flying, the first officer (FO), who was the pilot monitoring, and the check captain.

The crew planned to enter the Port Macquarie non-directional (radio) beacon (NDB)[1] holding pattern at 3,600 ft and then conduct an NDB approach to runway 21 (Figure 1 and Figure 2).

At about 1648 Eastern Daylight-saving Time,[2] the crew broadcast a call on the Port Macquarie common traffic advisory frequency (CTAF) advising they were intending to track overhead the airport for an NDB approach to runway 21, descending not below 3,500 ft, and with an expected arrival time of 1656.

At about 1651, the crew broadcast another call on the CTAF advising they were 16 NM to the south on descent, not below 3,500 ft, and with an expected arrival time of 1657. The check captain reported that there was a high amount of traffic operating in the area at the time.

About 1 minute later, the crew heard a taxi call from the crew of an Eastern Australia Airlines Bombardier DHC-8-315 aircraft, registered VH-TQZ (TQZ), operating an IFR scheduled passenger service from Port Macquarie to Sydney. Immediately after, the crew of TQZ broadcast they were entering and back tracking for a departure on runway 03. At that time, FVH was established in the NDB holding pattern, maintaining 3,600 ft.

The check captain of FVH reported that the aircraft was in-and-out of instrument meteorological conditions (IMC)[3] and the FO was busy communicating with the traffic in the area.[4]

Shortly after, the crews of both FVH and TQZ discussed their respective positions and intentions and the crew of TQZ stated that they would advise FVH when they were about to take off.

At 1656, when lined up on runway 03, the crew of TQZ observed FVH on the aircraft's traffic alert and collision avoidance system (TCAS),[5] positioned directly overhead the airport and turning outbound in the holding pattern. The crew of TQZ broadcast a call advising FVH they were about to commence the take-off run and intended to conduct a left turn at 600 ft.

1 A radio transmitter at a known location, used as a navigational aid. The signal transmitted does not include inherent directional information.

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

3 Describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under IFR, rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

4 Port Macquarie is classified as a non-towered aerodrome; an aerodrome at which air traffic control is not operating. Pilots are responsible for maintaining aircraft separation with other aircraft.

5 TCAS is an aircraft collision avoidance system. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder and gives warning of possible collision risks.

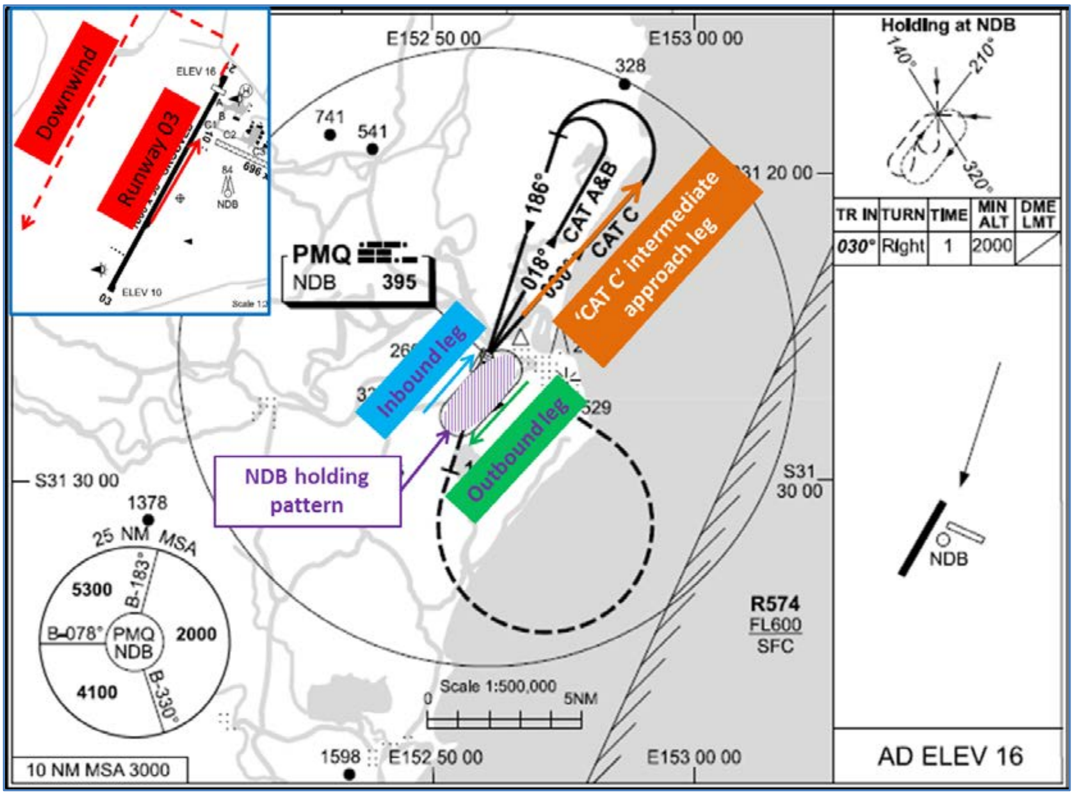
They further stated that they should be well clear and had them sighted on the aircraft's TCAS. The crew's intention was to depart on the downwind leg of the circuit as they were unable to track to the west due to visual flight rules (VFR) traffic operating in that area. The check captain of FVH reported that he could not recall hearing the pre-take-off broadcast made by TQZ. The recordings of the transmissions broadcast on the CTAF indicated that the crew of FVH responded, advising that TQZ was also sighted on their TCAS. Shortly after, the crew of FVH further advised TQZ that they would remain in the holding pattern at 3,600 ft until TQZ had departed.

The recorded CTAF transmissions also showed a number of other aircraft operating in the area at the time, and the crews of TQZ and FVH communicating with these aircraft for aircraft separation.

When on downwind, the captain of TQZ reported looking at the TCAS and having ensured that all known traffic had been accounted for. At 1658, the crew broadcast a call advising they were departing downwind, climbing through 2,600 ft, and appeared to be clear of FVH. The crew of FVH acknowledged the call and immediately after, advised that they were turning inbound in the holding pattern.

As TQZ approached 3,000 ft, in IMC, the captain observed an aircraft on the TCAS, above. The captain reported that, initially, he was unsure of which aircraft was being observed, but then identified it as FVH. The captain then instructed the FO to stop the climb and turn the aircraft to the right. Shortly after, the crew received a TCAS traffic advisory (TA)[6] and then an initial resolution advisory (RA)[7] to descend, followed shortly after by an RA to 'adjust vertical speed'. At the same time, while also in IMC, the crew of FVH also reported receiving a TCAS TA and then a TCAS RA to climb. The captain immediately responded and climbed the aircraft. The captain of TQZ reported that, according to the TCAS, there was about 400 ft vertical and 1 NM lateral separation between the aircraft. Both flights continued without further incident.

Figure 1: Port Macquarie NDB approach



Source: Airservices Australia

6 When a TA is issued, pilots are instructed to initiate a visual search for the traffic causing the TA.

7 When an RA is issued, pilots are expected to respond immediately to the RA unless doing so would jeopardize the safe operation of the flight.

Pilot comments (VH-TQZ)

The captain of TQZ provided the following comments regarding the incident:

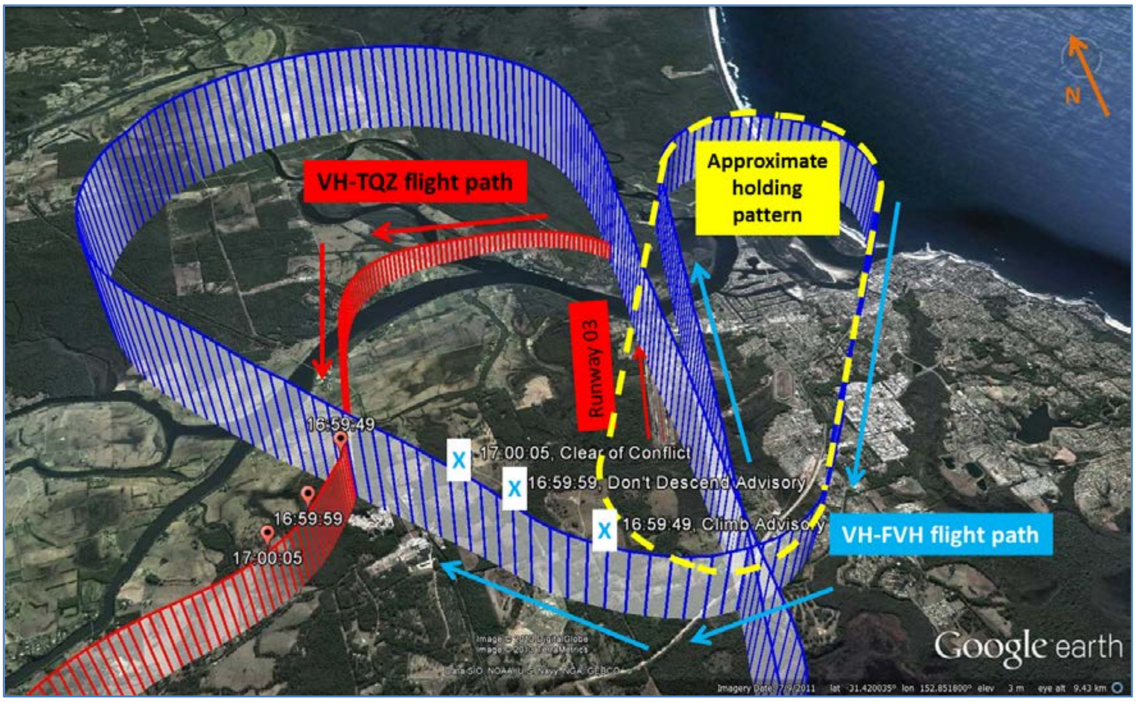
- The inbound leg of the NDB holding pattern was positioned west of the runway and was aligned with the intermediate approach leg of the 'CAT C'[8] NDB approach (Figure 1). The captain was of the understanding that the inbound leg was directly aligned with the runway.
- There was a considerable amount VFR and IFR traffic operating in the area at the time.

Recorded information

The flight data recorders (FDR) were downloaded from TQZ[9] and FVH and the data provided to the ATSB. The data showed the following (Figure 2):

- At 1659:49, while at 3,536 ft, the crew of FVH received a TCAS RA to climb.
- At 1659:53, FVH commenced a climb.
- At 1659:52, separation between FVH and TQZ reduced to about 290 ft vertically and 1.6 NM horizontally.
- At 1659:55, TQZ was observed commencing a descent.
- At 1659:59, the crew of FVH received a 'do not descend' TCAS RA.
- At 1700:05, the crew of FVH received a 'clear of conflict' TCAS message.

Figure 2: Summary of flight data



Source: Google earth

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8 Instrument approach procedures are designed to accommodate varying aircraft performance by the use of an aircraft performance category based upon the aircraft's indicated airspeed at the threshold. CAT C speeds are from 121 kt to 140 kt.

9 The flight data obtained from TQZ did not contain any parameters relating to the TCAS system.

Safety message

Situation awareness can be broadly described as the continual monitoring of the environment, being aware of what is going on, and detecting any changes. It is essential that pilots monitor their surroundings and have an awareness of traffic disposition. It is important to know where the traffic is and where it will be in relation to you, so that potential issues can be identified and actioned, before they escalate. This is particularly important when operating at non-towered aerodromes, where aircraft separation is pilot responsibility.

An ATSB research report *A pilot's guide to staying safe in the vicinity of non-towered aerodromes* (www.atsb.gov.au/publications/2008/ar-2008-044(1).aspx) highlighted the many challenges pilots faced when using, or flying in the vicinity of non-towered aerodromes. These can include:

- different operating procedures that are specific to non-towered aerodromes
- fitting into the circuit traffic
- communicating with other aircraft to arrange separation
- a mixture of aircraft types, performance levels, and operation types
- dealing with threats and hazards that may be encountered, such as unannounced traffic, or unexpected manoeuvres by nearby aircraft.

General details

Occurrence details

Date and time:	12 February 2013 – 1659 EDT	
Occurrence category:	Serious incident	
Primary occurrence type:	Aircraft separation – TCAS/ACAS	
Location:	Port Macquarie, New South Wales	
	Latitude: 31° 26.15' S	Longitude: 152° 51.80' E

Aircraft details: VH-FVH

Manufacturer and model:	ATR – GIE Avions de Transport Regional ATR72-212A	
Registration:	VH-FVH	
Operator:	Skywest Airlines	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 4	Passengers – Unknown
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

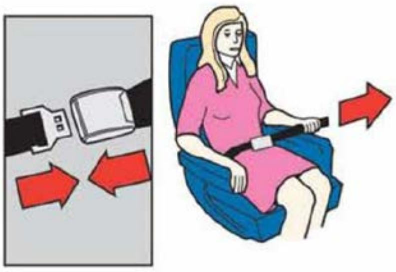
Aircraft details: VH-TQZ

Manufacturer and model:	Bombardier Inc. DHC-8-315	
Registration:	VH-TQZ	
Operator:	Eastern Australia Airlines	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 4	Passengers – 47
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Turbulence encounter involving a Bombardier DHC-8-402, VH-QOD

What happened

Keep your seatbelt fastened



Source: ATSB

On 10 May 2013, at about 2000 Eastern Standard Time,[1] a Sunstate Airlines Bombardier DHC-8-402 aircraft, registered VH-QOD (QOD), departed Townsville on a scheduled passenger flight to Cairns, Queensland.

About 20 minutes into the flight, the aircraft was in the cruise at flight level (FL) [2] 180 and flying in clear air when the aircraft encountered light turbulence. The captain immediately turned the seat belt sign on. A second later, the aircraft encountered abrupt severe turbulence.[3]

The autopilot disconnected and the captain, as pilot flying,[4] assumed manual control of the aircraft. The flight crew reduced the speed of the aircraft to below the turbulence penetration speed.[5] The turbulence event lasted about 10 seconds, during which time the aircraft climbed about 400 ft above the cruising altitude. The flight crew then re-engaged the autopilot and returned the aircraft to the assigned level.

The flight crew did not observe the aircraft fly through any cloud and the weather radar did not show any significant weather for the entire flight. The weather radar was on the first officer's multi-function display (MFD) display at all times throughout the flight.

At the same time, the cabin crew had completed the food service and were handing out drinks. Both members of the cabin crew were standing when the aircraft encountered the turbulence and they impacted the roof before falling to the floor. Both sustained head injuries and one was knocked unconscious.

One member of the cabin crew called the captain and advised him that both of them were bleeding from the head. There were drinks spilled throughout the cabin, some reading material had dislodged from the exit rows, but the cabin was otherwise secure. No passengers were injured in the incident as all had been seated with their seatbelts fastened. An able-bodied passenger (ABP) assisted with the other cabin crew member who was incapacitated.

In the cockpit, the flight crew's navigation bags dislodged from their aluminium frame and the captain's bag had hit the roof before landing on his lap. The flight crew sustained minor injuries and objects were strewn throughout the cockpit. The flight crew conducted a check of all switches and circuit breakers, confirmed there were no warnings or cautions, and checked for any objects that may have fouled the rudders and other flight controls. The aircraft was fitted with a library, which was contained beneath the cockpit floor and secured by two latches. The lid had been dislodged by the turbulence and the contents were thrown around the cockpit.

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1. Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.
2. 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 180 equates to 18,000 ft.
3. Severe turbulence is characterised by large, abrupt changes in altitude/attitude, with large variations in indicated airspeed. The aircraft may be temporarily out of control.
4. Pilot flying (PF) and pilot monitoring (PM) are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF's actions and aircraft flightpath.
5. Turbulence penetration speed (or manoeuvring speed) is defined as the maximum speed at which full abrupt control deflection can be made without exceeding the design load factor of the aircraft.

The captain reassured the cabin crew member and advised her to check that the passengers were uninjured. He made an announcement to inform and reassure the passengers and requested the cabin crew member secure the cabin for landing. The flight crew elected to continue the flight to Cairns and requested emergency services to be available on arrival.

The aircraft landed in Cairns about 20 minutes later without further incident and the cabin crew were transferred to hospital.

Recorded information

The flight data recorder (FDR) was downloaded and provided to the Australian Transport Safety Bureau (ATSB) for analysis. The data showed that, during the incident, a positive vertical acceleration value of 1.5g was recorded, 1 second later a negative vertical acceleration of 1.4g was recorded, followed by a positive vertical acceleration of 1.6g. The negative vertical acceleration experienced by the aircraft caused the cabin crew and unsecured objects to be thrown into the air.[6]

Flight crew comments

The flight crew reported that, due to the long moment arm of the DHC-8-400 series aircraft, the rear of the aircraft is more unpleasant during turbulence encounters. Both cabin crew members were at the rear of the cabin during the event.

Meteorological information

Bureau of Meteorology report

The Bureau of Meteorology (BoM) provided the ATSB with a report detailing the weather at the time of the incident including conditions, forecasts, warnings, and satellite and radar imagery.

The Townsville weather radar indicated a band of showers in the area of the incident up to FL195 that reached a peak altitude and intensity around 2010 as they passed from the east-south-east. The report indicated that this was likely to have contributed to atmospheric disturbances causing turbulent eddies.

The report stated that a stable atmosphere between FL170 and FL200 may also have contributed to the incident. The showers (or any updraft) would have been unable to extend above this layer, which may have led to significant localised wind shear, and turbulent energy propagating horizontally.

Area forecasts (ARFOR)

In order to facilitate the provision of aviation weather forecasts by the BoM, Australia is divided into a number of forecast areas. The flight covered two adjacent areas, Area 44, which included Townsville Airport and Area 45, which included Cairns Airport. The Area 44 ARFOR, valid from 1500 to 0300 on 10 May 2013, forecast scattered cumulus clouds[7] extending to 9,000 ft, becoming broken with tops at 18,000 ft in the vicinity of rain showers. Moderate turbulence was forecast in the larger cumulus clouds.

The Area 45 ARFOR, valid from 1251 to 0300 on 10 May 2013, forecast scattered cumulus clouds extending to 15,000 ft, becoming broken near precipitation. Moderate turbulence was forecast in the cumulus clouds.

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6 Vertical acceleration was recorded 8 times per second. The sensors that measure acceleration were located near the centre of gravity of the aircraft and the acceleration experienced at other points on the aircraft may have differed from the values recorded.

7 Cloud cover is normally reported using expressions that denote the extent of the cover. The expression Few indicates that up to a quarter of the sky was covered, Scattered indicates that cloud was covering between a quarter and a half of the sky. Broken indicates that more than half to almost all the sky was covered, while Overcast means all the sky was covered.

Seat belt sign and cabin crew procedures

The cabin crew reported that there were two normal procedures for illuminating the seat belt sign. If the flight crew were aware of possible turbulence approaching, they will contact the cabin crew to notify them, advise them how long they have to secure the cabin and switch on the seatbelt sign. The cabin crew will then advise the passengers and take their own seats. If it is urgent, the flight crew switch on the seatbelt sign and announce ‘cabin crew be seated’. This advises the cabin crew to be seated immediately and they will sit in the nearest available seat or wedge themselves into a position to be safe.

In this incident, the flight crew illuminated the seat belt sign but were unable to make an announcement or contact the cabin crew prior to encountering the turbulence. One cabin crew member attempted to wedge herself between seats, but did not succeed.

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.

Sunstate Airlines

The operator conducted an internal investigation into the occurrence and identified actions for further review, although not specific to this incident. The operator has advised the ATSB that they propose taking the following safety actions:

- reviewing the usage of weather radar, and raising the weather radar reliability with the aircraft manufacturer
- sharing the investigation learnings with all flight crew and cabin crew.

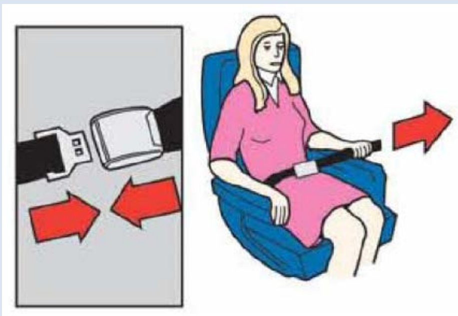
Safety message

Clear air turbulence is often unexpected, is hard to detect, can occur when no clouds are visible, cannot be detected by aircraft radar and is common at the high altitudes that airliners cruise at. The ATSB publication *Staying Safe against In-flight Turbulence* reported that, between January 1998 and May 2008, there were 339 turbulence occurrences in Australia reported by airlines to the ATSB. These resulted in over 150 minor and serious injuries to passengers and cabin crew. The report noted that almost all injuries involved people who were not properly seated and did not have their seatbelts fastened.

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.



In this event, all passengers were seated with their seat belts fastened, even though the seat belt sign had been switched off earlier. The fact that none of the passengers were injured highlights the benefits of keeping your seatbelt fastened during the flight.

Cabin crew are at greater risk of injury during turbulence encounters as they are moving around the cabin and not seated with a seat belt fastened.

The following publications provide additional information:

- *Staying Safe against In-flight Turbulence*, www.atsb.gov.au/publications/2008/ar2008034.aspx
- *Cabin Crew Safety 2001, January-February 2001*, http://flightsafety.org/archives-and-resources/publications/cabin-crew-safety/cabin-crew-safety-2001 .
- Roller Coaster Ride, how to minimise the risks of injury from in flight turbulence, in *Flight Safety Australia May-June 2006*, www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_91364

General details

Occurrence details

Date and time:	10 May 2013 – 2017 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Turbulence event	
Location:	49 NM north of Townsville, Queensland	
	Latitude: 19° 15.15' S	Longitude: 146° 45.92' E

Aircraft details

Manufacturer and model:	Bombardier DHC-8-402	
Registration:	VH-QOD	
Operator:	Sunstate Airlines	
Serial number:	4123	
Type of operation:	Air transport high capacity - passenger	
Persons on board:	Crew – 4	Passengers – 17
Injuries:	Crew – 4 minor	Passengers – Nil
Damage:	Nil	

Piston aircraft

Wheels up landing involving a Cessna 210, VH-ZMT

What happened

On 4 June 2013, a Cessna 210 aircraft, registered VH-ZMT, departed Elcho Island for Ramingining aerodrome, Northern Territory. The purpose of the flight was to pick up a passenger and return to Elcho Island about 15 minutes prior to last light.

The aircraft arrived at Ramingining and joined the downwind leg of the circuit for runway 09. The pilot completed his pre-landing checks, but inadvertently omitted to lower the landing gear and confirm that it had been extended.

When on final, the pilot was concentrating on the aircraft's airspeed and the touchdown point. He could not recall conducting his final checks, which included again confirming that the landing gear had been extended.

At about 100 ft, the pilot reduced the engine power to the idle position. During the landing flare,[1] the pilot felt that it was unusually smooth and the aircraft sank further than normal. The aircraft touched down and the pilot reported hearing a scraping sound and noticed that the propeller had come into contact with the ground. He then realised that the aircraft had landed with the landing gear retracted. The pilot stated that the aircraft's landing gear warning horn[2] did not sound at any stage during the landing.

Figure 1: VH-ZMT after landing

Source: Aircraft owner

[1] The final nose-up of a landing aircraft to reduce the rate of descent to about zero at touchdown.

[2] If the landing gear is not down and locked, and the throttle is reduced to the idle position, as in a landing approach, a landing gear unsafe warning horning will sound. The reason for the warning horn not activating could not be determined.

Pilot comments

The pilot provided the following comments regarding the accident and his inflight checks:

- He had a difficult passenger on board one of his previous flights and was 20 minutes behind schedule. As a result, the pilot reported that he was keen to get home, which had distracted him somewhat during the accident flight.
- The pilot checked the functionality of the landing gear warning horn during his daily pre-flight inspection, which operated as normal.
- When conducting his pre-landing checks, the pilot reported that he normally kept his hand on the landing gear lever until the gear had extended and the green landing gear down indicator light had illuminated. He also looked out the window to visually confirm the gear had extended.
- The pilot had considered arranging for someone else to conduct the flight to Ramingining, however, there was no other pilot available.

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 have issued a Flight Operation Service Notification to all pilots highlighting the requirement to follow checklists, including the pre-landing checklist.

Safety message

Broadly, distraction is defined as a process, condition or activity that takes a pilot's attention away from the task of flying. Research conducted by the Australian Transport Safety Bureau (ATSB) highlighted that, distractions were a normal part of everyday flying and that pilots generally responded to distractions quickly and efficiently, interspersing novel events with habitual, well-practiced sequences of actions. As a result of this, the impact of distraction on performance and aviation safety generally goes unnoticed. However, studies have also shown that pilots are vulnerable to distraction-related errors. This incident highlights the impact distractions can have on aircraft operations and the need for pilots to remain vigilant when completing checklists.

The following provide additional information on pilot distraction and

- Dangerous Distraction: An examination of accidents and incidents involving pilot distraction in Australia between 1997 and 2004: www.atsb.gov.au/publications/2005/distraction_report.aspx
- The United States Federal Aviation Administration (FAA) On Landings Part III pamphlet: www.faasafety.gov/files/gslac/library/documents/2011/Aug/56411/FAA%20P-8740-50%20OnLandingsPart%20III%20%5Bhi-res%5D%20branded.pdf
- YouTube video of an unintentional wheels up landing: www.flight.org/blog/2012/04/22/gear-up-landings-and-pilot-error/

General details

Occurrence details

Date and time:	4 June 2013 – 1751 CST	
Occurrence category:	Accident	
Primary occurrence type:	Wheels up landing	
Location:	Ramingining aerodrome, Northern Territory	
	Latitude: 12° 21.38' S	Longitude: 134° 53.85' E

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 210L	
Registration:	VH-ZMT	
Serial number:	21059880	
Type of operation:	Charter	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Collision on the ground involving a Cessna 172R, VH-IMS

What happened

On 2 August 2013, at about 1400 Eastern Standard Time,[1] the student pilot of a Cessna 172R aircraft, registered VH-IMS (IMS), conducted a solo navigation flight from Archerfield to Sunshine Coast via Caboolture, Queensland. After landing at Sunshine Coast Airport, the pilot taxied the aircraft to the general aviation apron.

Other aircraft were operating in the area and the pilot wanted to ensure he remained clear of them. The pilot noted a fence and power pole on his left, and then focused on an aircraft taxiing in front of IMS. While the pilot was watching the other aircraft taxiing, he advised that IMS may have rolled forward unnoticed. When the pilot commenced a right turn, the aircraft was past the end of the fence and as he turned the aircraft, the left wing collided with a power pole.

Figure 1: Aircraft wing damage and power pole

Source: Operator

Safety message

The pilot reported that he had learnt a valuable lesson from the accident, in that the flight is not over until the aircraft has been shut down and secured. In particular, this incident highlights the need to keep a good look out during taxi as well as in flight.

There are many visual illusions that can lead to incidents in aviation. In this accident, the pilot was watching an aircraft taxiing away from him. He thought that his aircraft was stationary, and was unaware that it had rolled forwards because of the perception of movement relative to the other aircraft. The aviation medicine website, www.avmed.in/2011/04/spatial-disorientation-visual-illusions/, provides additional examples of visual illusions common in aviation.

[1] Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

General details

Occurrence details

Date and time:	2 August 2013 – 1400 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision on the ground	
Location:	Sunshine Coast Airport, Queensland	
	Latitude: 26° 36.20' S	Longitude: 153° 05.47' E

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 172R	
Registration:	VH-IMS	
Serial number:	17280271	
Type of operation:	Flying training - solo	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Helicopters

Power loss involving a Robinson R44, VH-ZON

What happened

VH-ZON at accident site

Source: Pilot

On 15 July 2013, at about 1500 Central Standard Time,[1] a Robinson R44 helicopter, registered VH-ZON (ZON), departed from the helipad at Arkaroola, South Australia on a short scenic flight. On board were the pilot and two passengers.

On the return leg, at about 1510 and 3.5 NM east-north-east of the helipad, the pilot heard a loud noise from the rear of the helicopter, and suspected it was from the engine area. Almost immediately, the helicopter yawed to the right and began to descend. As there had been no indication of a possible mechanical issue during the flight, nor the previous two flights that day, the pilot reported being surprised at how quickly the situation had changed from normal, to a developing emergency.

The helicopter did not respond to the pilot's attempt to correct the yaw through his application of left anti-torque pedal. He noted there were no audible or visual warnings, so quickly scanned the instrument panel for any possible explanation. He could not recall seeing any abnormal instrument indications. The pilot advised his passengers of the situation and prepared them for an off-site emergency landing; radioed the helicopter's position and situation back to base; quickly sought out a landing area in the rugged terrain; and placed ZON into an autorotation.[2]

The pilot focussed on conducting the autorotation and landing, and ignored the repeated calls from base to check on the situation. The helicopter touched down on the rocky ridge and sustained substantial damage. After landing, the pilot noted the engine was not running, he shut the helicopter down and then checked on his passengers. The passengers did not sustain any injury.

Pilot experience and comments

The pilot reported conducting a thorough passenger and emergency briefing prior to the accident flight. This included location of the emergency locator transmitter (ELT), emergency rations location, ultra-high frequency (UHF) radio operation as well as the standard briefing including the operation of seat belts, doors, and exits.

The pilot held a Commercial Pilots (Helicopter) Licence, with about 190 hours total time, of which 11 hours were on the Robinson R44 helicopter. He also held a low-level endorsement.

The pilot commented on how quickly events unfolded, and how much quicker it was without the mental readiness that precedes autorotation practice conducted during training.

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

2 Autorotation is a condition of descending flight, where following engine failure or deliberate disengagement, the rotor blades are driven solely by aerodynamic forces resulting from rate of descent airflow through the rotor. The rate of descent airflow is determined mainly by airspeed.

Figure 1: VH-ZON at the emergency landing site

Source: Pilot

Engineering report – post accident

The operator arranged a full engineering inspection after the helicopter was retrieved. The insurance assessor also provided a further report of a detailed magneto inspection. The ATSB did not conduct an on-site investigation, and was not present at either of the two inspections.

At the time of the accident, the helicopter had 3,190.5 hours in service and had flown for 87.5 hours since the last 100-hourly inspection.

The magneto history report, provided to the ATSB by the insurance assessor, noted the following:

- The left magneto had been replaced twice since December 2012. The distributor block had been overhauled 32.1 hours prior to the accident.
- A detailed inspection of the magnetos found the right magneto was operating normally, but the left magneto had failed. The left magneto distributor block bearing had excessive movement beyond normal tolerances. This movement had allowed the timing gear to disengage and re-engage during operation, resulting in the significant alteration of the magneto timing. The incorrect timing may have opposed the operation of the right magneto, which could have resulted in an engine stall.

Figure 2: Two examples of unserviceable distributor blocks

Source: CASA Airworthiness Bulletin 74-005 Issue 1

The Civil Aviation Safety Authority (CASA) is aware of the existing problem with Teledyne Continental Motors and Champion Aerospace (Slick) magnetos. A search of the CASA Service Difficulty Report (SDR) database over the 24 months to June 2013 revealed nearly 45 per cent of ignition failures were attributed to magneto failures. On 24 July 2013, CASA issued Airworthiness Bulletin (AWB) No: 74-005, page 4 & 5, paragraph 3.3 – *Distributor Block Bearing Failures*. This AWB highlights many magneto related issues and indicates that despite close inspection of new distributor blocks, there is no way to determine if they will prove to be reliable. The AWB notes that this is currently the matter of an active on-going investigation in conjunction with manufacturers. Further reading is available at: www.casa.gov.au/wcmswr/_assets/main/airworth/awb/74/005.pdf

Safety message

This accident highlights the importance of thorough pre-flight safety briefs as conducted by the pilot in this situation. Although there were no injuries, the passengers were fully aware of the emergency exits and equipment had the outcome been different. The Australian Transport Safety Bureau (ATSB) safety research and analysis report B2004/0238, *Public Attitudes, Perceptions and Behaviours towards Cabin Safety Communications*, stated that when safety briefs are thoroughly and professionally delivered, the chances of survival for passengers increase. This report is available at www.atsb.gov.au/publications/2006/b20040238.aspx.

The pilot, although new to the type of helicopter, made clear decisions during an unexpected stressful situation. He continued to focus on the ‘aviate’ part of the time-proven message – ‘aviate, navigate, communicate’, despite the distraction of radio calls.

General details

Occurrence details

Date and time:	15 July 2013 – 1510 CST	
Occurrence category:	Accident	
Primary occurrence type:	Power loss	
Location:	11km NNE of Arkaroola (ALA), South Australia	
	Latitude: 30° 19.03' S	Longitude: 139° 23.65' E

Helicopter details

Manufacturer and model:	Robinson Helicopter Company R44	
Registration:	VH-ZON	
Serial number:	0179	
Type of operation:	Charter - passenger	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Total power loss involving a Bell 47G2A, VH-KHJ

What happened

VH-KHJ

Source: Pilot

On 23 July 2013, at about 0910 Eastern Standard Time,[1] the pilot of a Bell 47G2A helicopter, registered VH-KHJ (KHJ), departed Lake Manchester, Queensland, on a local aerial photography flight.

The flight involved orbiting over four different locations and positioning the helicopter for the on-board photographer at each site.

The flight was conducted largely within Amberley military controlled airspace. Before commencing the first photography session, air traffic control (ATC) instructed the pilot to hold outside the controlled airspace and await a further clearance. While holding, the pilot noticed the engine revolutions per minute (RPM) decrease slightly. After a minor adjustment to the throttle and collective, the RPM returned to normal.

The pilot reported that he had taken off with carburettor heat on, as it was required for the climb. He had then adjusted the amount of carburettor heat required as indicated by the carburettor gauge. He referred to the gauge about every 30 seconds during the flight.

During the third photography shoot, the pilot was climbing through about 1,300 ft above mean sea level (AMSL) when the engine stopped suddenly.

The pilot immediately lowered the collective[2] and established the helicopter in an autorotation.[3] He selected an appropriate landing area and broadcast a 'MAYDAY'[4] call. Just before reaching the ground, the pilot flared[5] the helicopter for landing. Within 40 seconds of the engine failure, the helicopter landed heavily and was substantially damaged. Neither the pilot nor the photographer was injured.

Almost no carburettor heat was on, with the lever at about 1/8th of the available travel at the time of the incident.

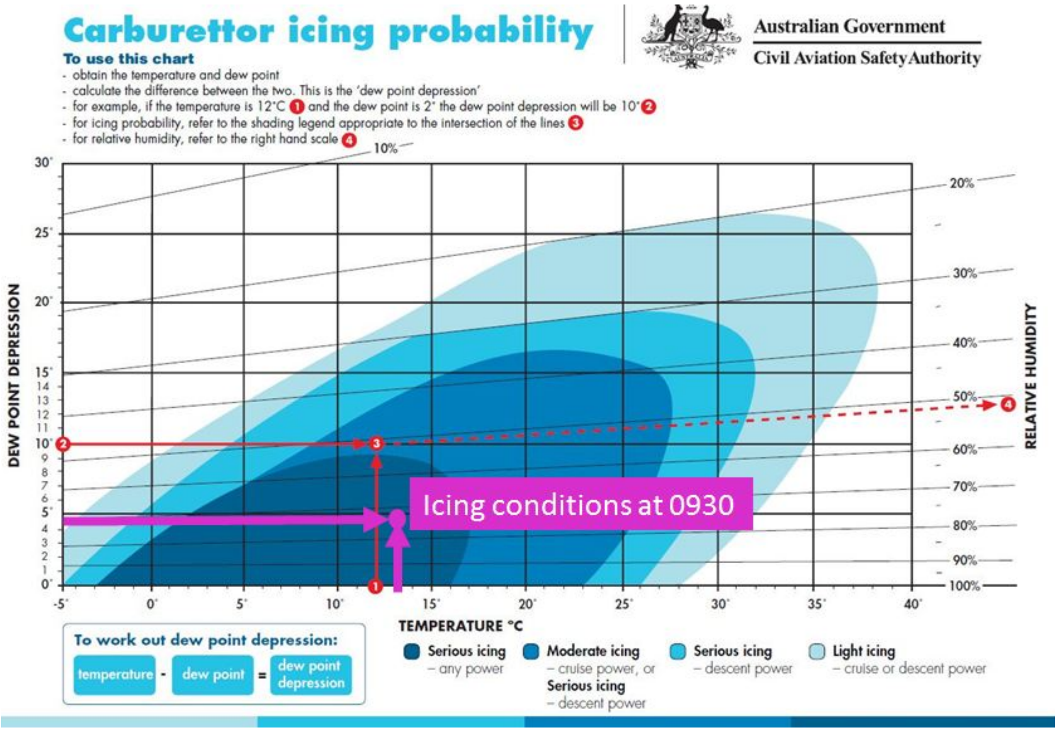
Meteorological conditions

Weather observations from the Bureau of Meteorology's automatic weather station at Amberley indicated that at 0930, the temperature was 13.5° C and the dew point[6] was 9.1° C. The dew point depression was calculated by subtracting the dew point from the temperature, and at that time was 4.4.

1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.
2 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.
3 Autorotation is descent with power off, air flowing in reverse direction upwards through lifting rotor(s), causing it to continue to rotate at approximately cruise rpm. Pilot preserves usual control functions through pedals, cyclic and collective but cannot grossly alter steep 'glide path'.
4 Mayday is an internationally recognised radio call for urgent assistance.
5 Flare is aimed to reduce rate of descent before ground impact by increasing collective pitch; this increases lift, trading stored rotor kinetic energy for increased aerodynamic reaction by blades, and should result in a gentle touchdown.
6 Dewpoint is the temperature at which water vapour in the air starts to condense as the air cools. It is used among other things to monitor the risk of aircraft carburettor icing or likelihood of fog at an aerodrome.

According to the Carburettor Icing Probability chart (Figure 1), the conditions indicated a serious probability of carburettor icing at any power.

Figure 1: Carburettor icing probability



Source: Civil Aviation Safety Authority

Insurance assessment

When the insurance assessor arrived on site, the helicopter engine was started and performed without fault. No fuel contamination was found. Other than the damage sustained in the accident, the helicopter was reported to have been well maintained and in excellent condition.

The insurance assessor considered that the weather conditions were an incipient cause of the incident. At the time, the temperature and dew point indicated a risk of serious carburettor icing. The pilot reported that he would have expected the engine to run roughly if carburettor icing was present.

Figure 2: Damage to VH-KHJ

Source: Pilot

Safety message

All pilots of aircraft fitted with a carburettor are advised to check the forecast conditions and know the risk of carburettor icing prior to each flight. The carburettor icing probability chart is available at www.casa.gov.au/wcmswr/_assets/main/pilots/download/carburettor_icing_chart.pdf.

The following publications provide additional information on carburettor icing:

- Melting Moments: Understanding Carburettor Icing
  www.atsb.gov.au/publications/2009/carburettor-icing.aspx
- Flight Safety Australia – A chill in the air
  http://casa.realviewtechnologies.com/?iid=47830&startpage=page0000030
- Mornington Sanford Aviation – No ice, thank you
  www.morningtonsanfordaviation.com/mornington-sanford-aviation-articles.html#ice
- Helicopter Safety – Carb Icing
  www.helicoptersafety.org/genericaccident.asp?Keyword=Carb%20Icing

General details

Occurrence details

Date and time:	23 July 2013 – 0950 EST	
Occurrence category:	Accident	
Primary occurrence type:	Total power loss	
Location:	6 NM E of Amberley Airport, Queensland	
	Latitude: 27° 39.58' S	Longitude: 152° 49.35' E

Helicopter details

Manufacturer and model:	Bell Helicopter Company 47G2A	
Registration:	VH-KHJ	
Serial number:	478	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Hard landing involving a Bell 206B, VH-EPQ

What happened

On 31 July 2013, at about 1500 Eastern Standard Time,[1] an instructor and pilot under review departed Bankstown, New South Wales, in a Bell 206B helicopter, registered VH-EPQ (EPQ), to conduct a Helicopter Flight Review (HFR).[2] Having completed a number of other activities, the pilot under review was conducting practice autorotations[3] just south of Bringelly.

The pilot in command was an experienced instructor with about 3,500 hours total experience. The instructor advised the ATSB that the crew had conducted three practice autorotations with the planned completion of each exercise and go-around at about treetop height. The instructor reported that because they intended to go around, the flare was conducted higher than if they had planned to land. The procedure involved the pilot flaring[4] the helicopter as if to land, then increasing throttle, raising collective[5] and climbing away. The flare was initiated by aft cyclic[6] movement, which tilts the disc rearward reducing airspeed and rate of descent.

The instructor reported that after they had completed three autorotations, the pilot under review requested they carry out one more. He advised the ATSB that in initiating a practice autorotation, if the throttle is just wound off and the collective is lowered instantly, the engine will overspeed, with the potential to cause significant damage. His technique for initiating an autorotation is to roll the throttle off gently then lower collective.

At the commencement of the last autorotation, the instructor noticed that the pilot was heavy on the controls and asked him to ‘relax his grip on the throttle’. At the flare point, the instructor attempted to increase the throttle, but he was unable to apply pressure against the pilot under review’s resistance, which prevented him from increasing to full flight RPM. At that stage, the instructor considered that there was insufficient time to perform a power recovery, so he elected to perform an engine off landing. The instructor then noticed decaying rotor RPM so levelled the aircraft and tried to cushion the helicopter onto the ground with remaining RPM.

The helicopter contacted the ground with a slight nose-high attitude and as a result, the back of the skids contacted the ground, and with the rotor RPM now decayed, the rotor struck the tail boom, resulting in substantial damage. The crew were uninjured.

In a written report obtained by the ATSB, the pilot under review reported that after a stopover at a homestead, the crew flew the helicopter to the training area to conduct a practice autorotation. He reported that after the first autorotation, the instructor told him that he had let the rotor RPM drop to about 95% and should be mindful to keep it at 100%, and that they both agreed the flare could have been smoother and should try again. After climbing to 1,500 ft, they entered a second autorotation with power going to idle. The pilot under review reported that he noticed with

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

2 The Civil Aviation Safety Authority requires all private and commercial helicopter pilots to undergo a Helicopter Flight Review (HFR) every 2 years to maintain validation of their pilot licence. See Appendix C of CAAP 5.81-1(1).

3 Autorotation is a condition of descending flight where, following engine failure or deliberate disengagement, the rotor blades are driven solely by aerodynamic forces resulting from rate of descent airflow through the rotor. The rate of descent is determined mainly by airspeed.

4 Flare is aimed to reduce rate of descent before ground impact by increasing collective pitch; this increases lift, trading stored rotor kinetic energy for increased aerodynamic reaction by blades, and should result in a gentle touchdown.

5 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.

6 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.

collective down he had to increase descent speed to 68-70 kt to maintain rotor RPM at 100%. He reported that this meant they had a faster approach to ground than the previous autorotation.

The pilot under review reported that when he entered the flare and in the hover, he noticed the rotor RPM was low and didn't think he could maintain a hover while RPM was decaying, 'so we landed'. Upon landing he noticed a black object go past his peripheral vision on the starboard side. The pilot under review considered that there must have been too much aft cyclic on landing that allowed one rotor blade to contact the tail rotor boom.

ATSB comment

The ATSB was unable to reconcile the differences in the two pilot reports.

Safety message

The Federal Aviation Authority (FAA) reported that a high number of accidents were associated with the practice autorotation with a power recovery and the American Aircraft Owners and Pilots Association (AOPA) found that more accidents happen each year from practice autorotations than from actual engine failures. The following links provide information regarding accidents related to practice autorotations:

- www.ainonline.com/aviation-news/hai-convention-news/2012-02-13/instructor-pilots-give-guidance-autorotation-training
- www.ainonline.com/aviation-news/aviation-international-news/2013-05-01/astar-accident-shines-light-autorotation-training
- www.aviationtoday.com/rw/training/specialty/Flight-Training-Tips-Dancing-With-the-Devil_13632.html
- http://blog.aopa.org/helicopter/?p=725
- www.robinsonheli.com/srvclib/rhcsn-38.pdf
- www.faa.gov/documentLibrary/media/Advisory_Circular/AC_61-140.pdf
- www.faasafety.gov/files/gslac/library/documents/2011/Aug/56414/FAA%20P-8740-71%20Planning%20Autorotations%20[hi-res]%20branded.pdf

General details

Occurrence details

Date and time:	31 July 2013 – 1600 EST	
Occurrence category:	Accident	
Primary occurrence type:	Hard landing	
Location:	9 km north of Camden Airport, New South Wales	
	Latitude: 33° 57.52' S	Longitude: 150° 42.52' E

Helicopter details

Manufacturer and model:	Bell Helicopter Company 206B	
Registration:	VH-EPQ	
Type of operation:	Flying training	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

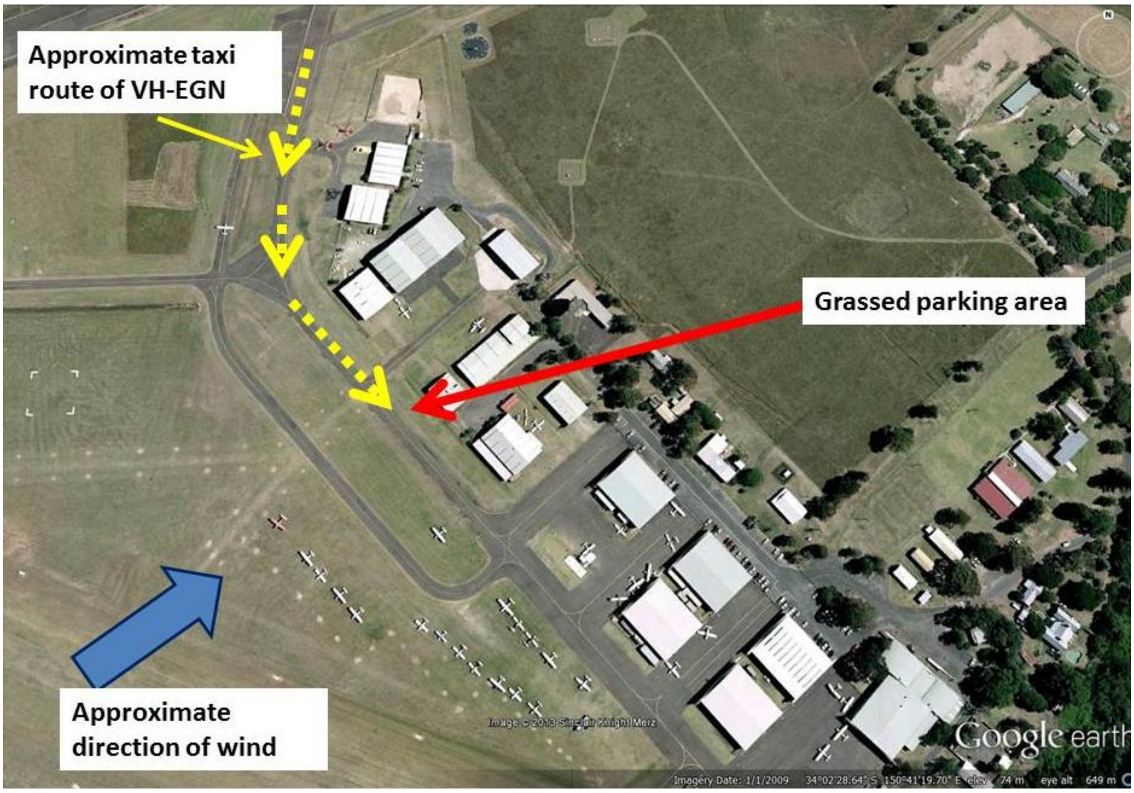
Loss of control involving a Robinson R22, VH-EGN

What happened

On 7 August 2013, at about 0800 Eastern Standard Time (EST),[1] the student pilot of a Robinson R22 helicopter, registered VH-EGN (EGN), commenced his first training flight for the day at Camden Airport, New South Wales. The flight involved a dual check, followed by solo circuit practice. After the circuit practice, the student returned to the grassed parking area near the flying school hangar (Figure 1) and parked EGN facing east, as briefed by his instructor. This manoeuvre was observed by his instructor.

After a break, and a further briefing by his instructor highlighting turning and downwind operations, including instructions for returning to the grassed parking area, the student departed for his second training flight of solo circuits. His instructor observed the departure and the majority of the solo session, as he was airborne in another company helicopter also conducting circuits. Throughout the training session, the Bureau of Meteorology automatic weather station (AWS) indicated that the wind was predominantly west-south-westerly, between 6-10 kt.

Figure 1: Camden Airport



Source: Google earth

At the end of the solo circuits, the student taxied EGN back toward the hangar and reported the wind was coming from his right. At about 1055, the helicopter approached the parking area. While facing an easterly direction and hovering at about 3 ft above ground level, the student commenced a left pedal turn at low airspeed to position the helicopter in a westerly direction for landing.

[1] Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

The helicopter commenced turning left. When in a downwind position, the student reported that the helicopter weather-cocked into wind and the rotational speed rapidly increased. The student attempted to stop the rotation by applying full right pedal, but the helicopter continued to rotate left. The student lowered[2] the collective to land EGN and the right skid contacted the ground followed by the tail rotor.

The helicopter was shut down and the student exited. The student was not injured, but the helicopter sustained substantial damage (Figure 2).

Figure 2: VH-EGN damage

Source: Peter Holstein

Pilot experience and comments

The pilot held a Student Pilot Licence, with about 36 hours total time, of which 29 hours were on the Robinson R22 helicopter, including 4 hours of solo time. In the last 90 days, the student had accrued 5 hours on the R22.

The student said that he had been briefed on the conditions that could lead to weathercocking and had also noticed his instructor responding to this effect in much stronger wind conditions during dual training. He reported that he had been cautious in applying left pedal to turn the helicopter and did not believe that the relatively benign weather conditions would be sufficient to induce a weathercocking event. In addition, he had also successfully taxied to and from the hangar and parked on his own, on two occasions prior to the accident flight.

The student reported that he intends to undertake more dual hover training in various wind conditions to become proficient in identifying a potential weather cock situation.

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2 In the absence of any other control inputs, when the collective is lowered the helicopter will yaw left.

Operator comment

The operator reported that it was company procedure to accompany student pilots to/from the hangar (with an instructor remaining in the vicinity of the main helipad) for at least the first 3 hours of solo flying.

Weathercock stability

The United States Federal Aviation Administration (FAA) *Helicopter Flying Handbook*[3] states that the nose of a helicopter will attempt to weathercock into the relative wind when a tailwind from 120° to 240° is experienced. If sufficient resisting pedal input is not made by the pilot, the helicopter will start a slow, uncommanded turn to either the left or right, depending on the wind direction. If the yaw rate is allowed to develop and the tail of the helicopter moves into this region, the yaw rate can accelerate rapidly.

The FAA further stated that, when approaching the downwind portion of a turn, anticipate the helicopter's tendency to weathercock by applying pedal pressure opposite to the direction of the turn.

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.

Operator

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

Operations Manual amendment

The operator has amended Part E of their Operations Manual to extend the time that a student pilot is monitored by an instructor returning to the parking area at the hangar. The new amendment now states:

> Annex 1 Section E2.25 TAXIING BY STUDENT PILOTS
>
> Solo taxi by student pilots shall only be permitted after 'first solo'. At all other times, taxiing shall be conducted as part of dual training under the strict supervision of an approved helicopter instructor. Student pilots may only return to the hangar parking area after having completed a minimum of 5 hours taxiing to/from hangar dual with an instructor on-board after having achieved First Solo.

Accident review

The operator's instructional staff have reviewed the accident and discussed the lessons learnt from the experience.

Safety message

Wind direction and velocity are important considerations for helicopter pilots, especially for hovering take-off and climb performance. When the wind strikes the aircraft from certain sectors, a sudden reduction in tail rotor efficiency can occur. If the helicopter is allowed to rotate or turn through certain wind directions, the rate of turn may accelerate. It is crucial that pilots maintain an awareness of the wind and be aware of the consequential effects on helicopter performance. This will assist pilots with responding promptly and appropriately to a situation and preventing a loss of control.

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3 www.faa.gov/regulations_policies/handbooks_manuals/aviation/helicopter_flying_handbook/

General details

Occurrence details

Date and time:	7 August 2013 – 1055 EST	
Occurrence category:	Accident	
Primary occurrence type:	Aircraft loss of control	
Location:	Camden Airport, New South Wales	
	Latitude: 34° 02.42' S	Longitude: 150° 41.23' E

Helicopter details

Manufacturer and model:	Robinson Helicopter Company R22 BETA	
Registration:	VH-EGN	
Serial number:	4538	
Type of operation:	Flying Training	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

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.

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Investigation

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