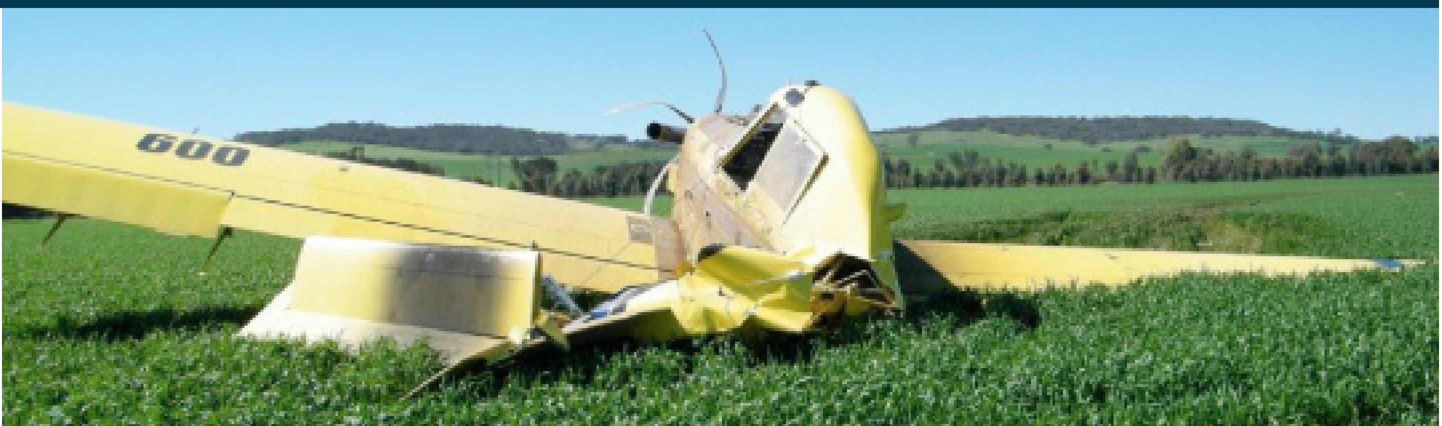
Australian Government
Australian Transport Safety Bureau

Aviation Short Investigation Bulletin Fourth Quarter 2011

Issue 8



Investigation

ATSB Transport Safety Report
Aviation Short Investigations
AB-2012-019
Final

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT

Aviation Short Investigations
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AB-2012-019	14 March 2012	978-1-74251-249-5

CONTENTS

Jet aircraft

Turboprop aircraft

Piston aircraft

Helicopters

INTRODUCTION

About the ATSB

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; and 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.

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.

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 is from the information provided in these notifications that the ATSB makes a decision on whether or not to investigate. While further information is sought in some cases to assist in making those decisions, resource constraints dictate that a significant amount of professional judgement needs to be exercised.

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

To enable this, the Chief Commissioner has established a small team to manage and process these factual investigations, the Short Investigation Team. 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. In addition, the ATSB may include an ***Safety Message*** that is directed to the broader aviation community.

The summary reports detailed herein were compiled from information provided to the ATSB by individuals or organisations involved in an accident or serious incident.

AO-2011-056: VH-NXE, Engine failure

Date and time:	2 May 2011, 0552 (WST)	
Location:	20 NM (37km) E Perth Airport, Western Australia	
Occurrence category:	Incident	
Occurrence type:	Single engine failure	
Aircraft registration:	VH-NXE	
Aircraft manufacturer and model:	The Boeing Company 717	
Type of operation:	Air transport –high capacity	
Persons on board:	Crew – 5	Passengers – 115
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Minor	

FACTUAL INFORMATION

On 2 May 2011, at 0552 Western Standard Time[1], a Cobham Aviation, Boeing 717 aircraft, registered VH-NXE (NXE), was being operated on a scheduled flight from Perth Airport to Mt Newman, Western Australia. At about 7,000 ft above ground level, during the climb, the crew heard a loud bang and felt the aircraft shake and yaw. The Pilot in Command (PIC), who was the pilot flying, confirmed that the left (Number 1) engine had failed and observed the turbine gas temperature (TGT) indicator was showing its maximum[2] reading. Slight airframe vibration was also felt followed by a momentary electrical power disruption to the cockpit display units and autopilot disconnection.

The crew re-engaged the autopilot and declared a PAN[3]. The crew then executed the memory items checklist for engine fire or severe damage. Air traffic control (ATC) at Perth vectored NXE until other checklists had been completed, then sequenced the aircraft to join the approach for an overweight landing on Runway 03.

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

2 The maximum temperature that was recorded, which was less than the actual temperature reached.

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

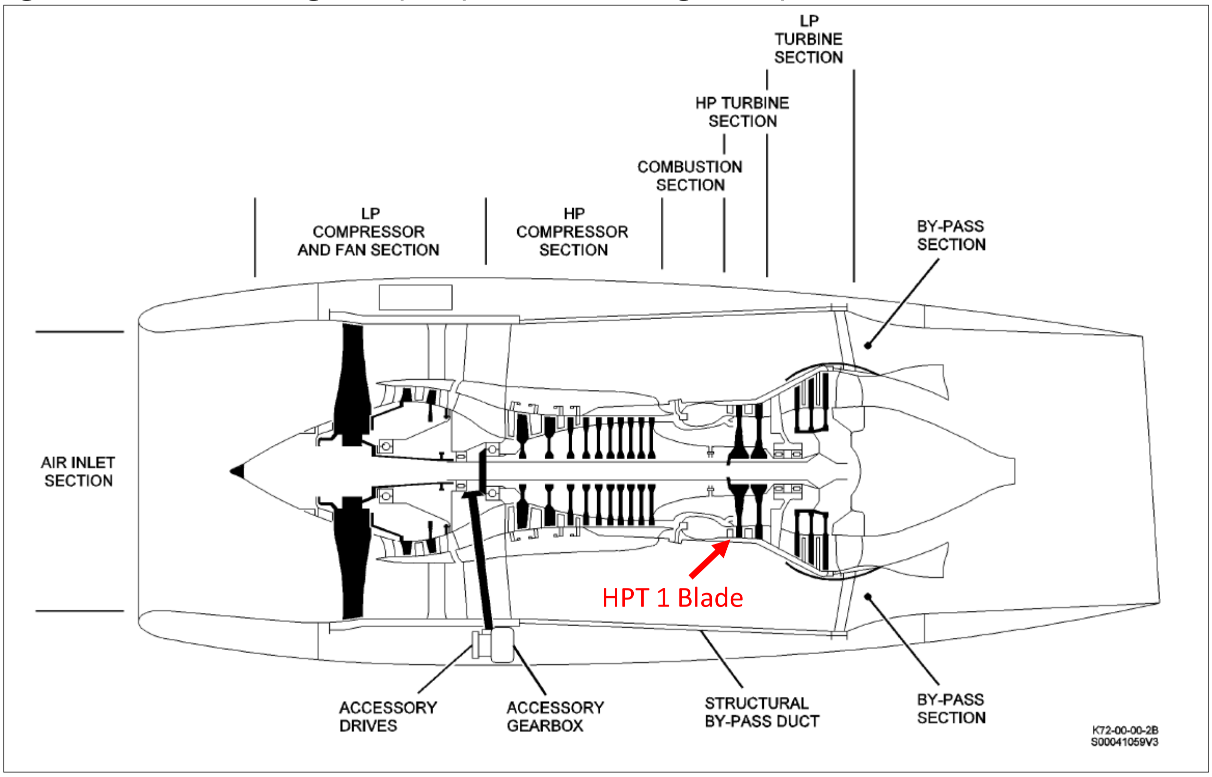
The aircraft was fitted with two Rolls-Royce BR 700-715 series engines. A subsequent examination of the left engine revealed metallic debris in the tailpipe and physical bulging of the high-pressure turbine (HPT) module. A detailed internal (borescope) inspection confirmed multiple failures of high-pressure turbine, stage-1 (HPT1) blades, with subsequent, downstream damage through to the third stage of the low-pressure turbine (LPT, Figure 1). Damage upstream of the HPT1 blades at the nozzle swirler inlet and nozzle guide vanes was also found. The engine was then shipped to the manufacturer for a teardown examination, which was witnessed by the BFU (German Federal Bureau of Aircraft Accident Investigation) on behalf of the Australian Transport Safety Bureau (ATSB).

Engine examination

During the teardown examination, the LPT section proved difficult to remove due to case deformation. In the HPT module, four of the second stage blades had failed at ⅓ or ½ their height. All of that stage's blade shrouds were missing. Examination of the first stage of the HPT module found all of the blades had fractured. Further observation identified that only one HPT1 blade had fractured below its root platform (Figure 2). Microscopic examination revealed that blade's failure had initiated at the inner shank wall on the pressure side[4].

4 The pressure side of any aerofoil is the non-convex side; in Figure 2, it is the right side of each blade.

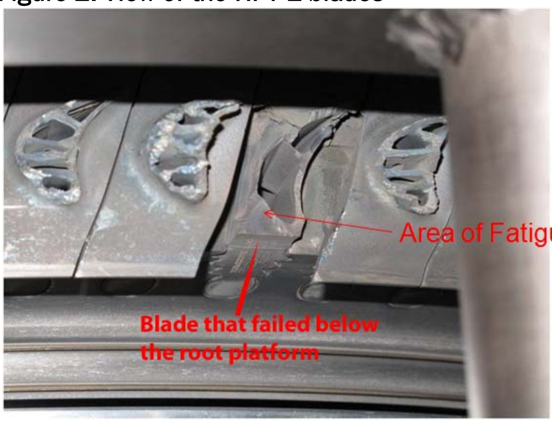
Figure 1: Schematic drawing of the principal BR 700-715 engine components



Drawing courtesy of The Boeing Company

The crack propagated via a fatigue mechanism through to the outer wall then spread laterally.

Figure 2: View of the HPT 1 blades

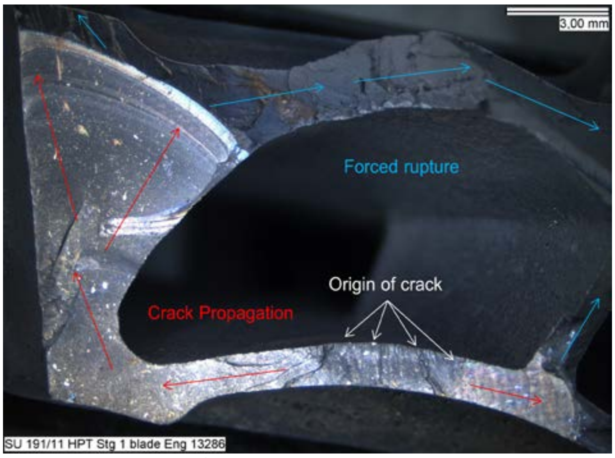


Photograph courtesy of Rolls Royce

Final failure of the blade was through overload (Figure 3). The liberated blade created a domino effect on other blades and components, leading to an engine surge and damage extending into the engine compressor stages.

Failure initiation was considered to be driven by thermo-mechanical loads. The crack progressed due to a combination of these loads and the influence of corrosion/oxidation. The failure characteristics were entirely consistent with those of previous HPT1 blades of this design standard.

Figure 3: Micro-photo of crack surface



Photograph courtesy of Rolls Royce

Recorded information

Analysis of data downloaded from the aircraft flight recorders revealed that engine surging occurred during climb through 6,400 ft. One second later, the "Engine Out" parameter became active. While both shaft speeds of the engine decreased abruptly, vibration indications increased from 0.3 to 2.7 units; an increase in the TGT was also shown.

A review of previous flight data confirmed there had not been any significant variations in engine vibration indications during the preceding 27 hours.

Engine information

The BR700-715 engine (serial number 13286) had completed 19,416 hours and 13,675 cycles since new. In 2003, the HPT1 blades were upgraded to the Life Improvement Package 3 (LIP-3) standard. Following a blade failure in July 2007 (ATSB investigation: AO-2007-024[5]) the blades were upgraded twice more to LIP-5 AL standard (aluminised coating). The engine had completed 4,381 hours and 2,116 cycles since that upgrade in November 2009.

Other occurrences

A 2004 ATSB Report (BO/200402948) identified a similar HPT1 blade failure within a BR700-715 engine installed with early LIP-design blades.

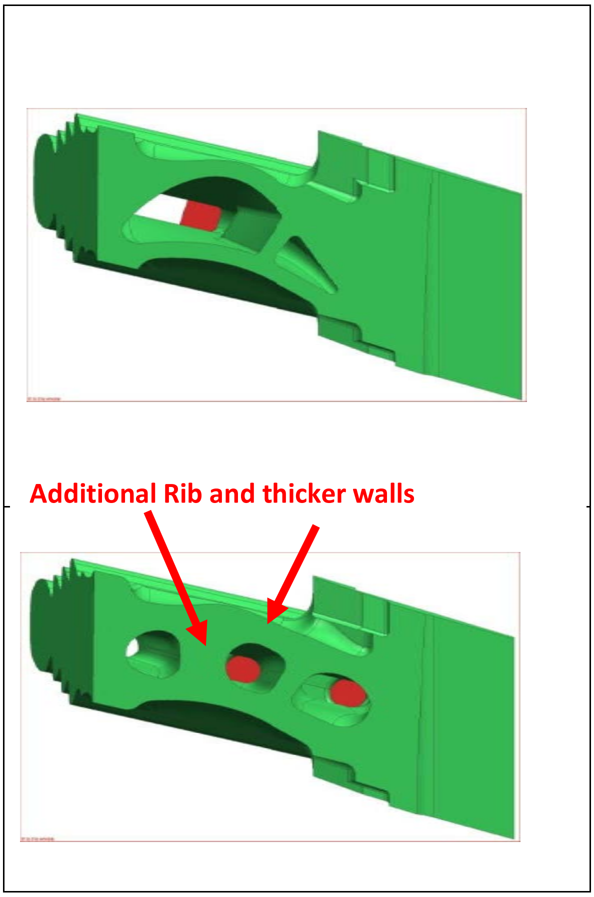
On 4 October 2011, a HPT1 blade fracture below its platform occurred on engine serial number 13148. (ATSB occurrence 201106376). That engine had been modified to LIP-5 standard in March 2010 and had operated for 3,585 hours and 2,221 cycles since then.

Engine HPT1 design changes

The five blade design changes in the LIP series included the addition of protective coatings and a modified internal cooling channel radius in the blade platform area.

A subsequent modification to the blades (designated 'Mk II') was introduced to lower the fatigue stresses within the blade, by adding a rib and increasing the shank wall thickness to further stiffen the cooling channel structure (Figure 4).

Figure 4: Cross-section of LIP standard (top) and Mk II standard (bottom) blades



Drawings courtesy of Rolls Royce

SAFETY ACTION

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

Manufacturer

The engine manufacturer advised that a series of Service Bulletins (SB) were relevant to the operator's BR700-715 engine fleet. The first, SB-72-A900528, was an April 2011 *Alert Non-Modification SB* requiring the de-pairing[6] of aircraft engines fitted with all LIP standard blades. This SB formalised an earlier de-pairing program that had been initiated in agreement with the European

5 Available on the ATSB website AO-2007-024

6 De-pairing is undertaken to ensure that no single aircraft carries two engines with an elevated risk of in-flight failure.

Aviation Safety Agency (EASA) in 2007. Following the subject engine failure, the SB was revised in June 2011, to reduce the de-pairing interval to 2,100 cycles for engines fitted with LIP-5 AL design blades.

The second relevant service bulletin, SB-72-900464, covered inspection of the HPT and combustion module during removal of the HP turbine rotor.

A third, SB-BR700-72-101671, covered the introduction of the revised Mk II HPT1 blades.

Operator

Cobham Aviation advised the ATSB that the following safety actions have been taken:

Engine De-Pairing program

The de-pairing program had been underway since 2007.

Engine replacement program

The operator's B717 fleet consisted of 14 LIP standard HPT blade engines and eight Mk II standard HPT blade engines. The operator plans to have all engines modified to the Mk II standard by December 2012.

AO-2011-065: VH-OQI, Diversion

Date and time:	0930 CST, 16 May 2011	
Location:	Adelaide Airport, South Australia	
Occurrence category:	Incident	
Occurrence type:	Fuel related event	
Aircraft registration:	VH-OQI	
Aircraft manufacturer and model:	Airbus Industrie A380-842	
Type of operation:	Air transport – high capacity	
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 16 May 2011, while at cruising altitude on a scheduled passenger flight from Changi Airport, Singapore to Melbourne, Australia, the crew of a Qantas Airways Airbus A380-842 (A380) aircraft, registered VH-OQI (OQI), noticed a significant discrepancy between the aircraft's fuel state and the fuel predictions. The crew monitored the fuel over the flight and determined that approximately 3.8 tonnes of excess fuel had been used over a 6 hour period

The crew established that between 1352 UTC[1] and 1825 UTC, the fuel burn was significantly high at about 2.7 tonnes over the 4½ hours, which equated to an excess fuel burn of about 600kg/hr. The crew considered a possible fuel leak, but a high fuel flow was deemed the most likely reason.

The crew were aware that the flight was scheduled to arrive at Melbourne Airport during restricted runway use due to runway maintenance. Because of concerns about the projected fuel state and possible delays in landing, they opted to divert to Adelaide Airport, South Australia landing at 0930 Central Standard Time[2], 16 May 2011.

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

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

Aircraft inspection

A subsequent inspection of the aircraft found no evidence of fuel system leaks, or any engine anomalies that would account for excessive fuel use. The aircraft manufacturer reviewed the fuel systems recorded data and confirmed that no discrepancies were identified between engine fuel consumptions and the respective fuel tank quantity variations.

The operator also concluded that the engine fuel flow was normal on all engines for the setting used during the flight.

Flight operating parameters

The operator reviewed data for the flight and calculated the fuel burn, based on the actual flight operating parameters, against those predicted in the flight management system (FMS) computer. Taking into consideration all variables such as head winds, weather, power settings and cruise altitude, the calculations revealed a negligible increase in fuel burn from that planned and did not account for the large discrepancy that was displayed.

Meteorological information

The Bureau of Meteorology's upper level wind and temperature charts showed the 'Grid Point' forecast and actual winds for the areas encompassing the aircraft's flight path. The charts indicated that the wind was mostly from an easterly direction, resulting in the flight being subject to a headwind component. There was no major variation between the forecast and actual winds.

The METAR[3] for Adelaide, issued at 1830Z (UTC) and current at the time of landing, indicated that the wind was from a direction of 030°, at a speed of 10kts, cloud and visibility conditions were CAVOK[4] and the temperature was 6° Celcius.

Recorded data

The Australian Transport Safety Bureau reviewed the flight data recorder and made a comparison of fuel flow with another A380 aircraft. The data showed the fuel flow was within normal range during the flight.

Performance Factor

During a review of data by the aircraft manufacturer it was identified that the Aircraft's Performance Factor (PF) in the FMS, had been changed during the flight. The PF provided a means of correcting the FMS 'standard' performance level to match the aircraft's actual performance level, in order to provide realistic predictions of fuel use. The operator advised that alteration of the PF in flight may slightly effect the FMS-provided predictions for fuel remaining at down track waypoints, but had no influence on actual fuel used. It was determined that the PF was altered after the fuel discrepancy had been identified. As such, it was considered to have been done as a fault finding measure, to identify a possible reason for the fuel discrepancy.

Subsequent flights

The aircraft was released back into service without any component replacement or system upgrades. None of the subsequent flights presented fuel discrepancies of note.

The operator also advised that a review of ongoing fuel monitoring information provided by flight crews had confirmed that fuel discrepancies of this magnitude have not been identified on any other A380 aircraft within the fleet.

[3] Routine aerodrome weather report issued at fixed times, hourly or half-hourly.

[4] Ceiling and visibility OK, meaning that visibility, cloud and present weather better than prescribed conditions. For an aerodrome weather report, those conditions are visibility 10 km or more, no significant cloud below 5,000 ft or cumulonimbus cloud and no other significant weather within 9 km the aerodrome.

Spoiler deployment

Subsequent investigation by the manufacturer and operator, including detailed analysis of the aircraft's recorded data, identified that, between 1220 to 1635 UTC, the speed brake lever (SBL) had been set away from the stowed position of -5° to a position of +3.6°.

As a result, all of the aircraft's flight spoilers were deflected slightly into the airstream, creating additional drag and increasing the fuel burn during the flight.

Crew Alerting

The spoilers were displayed on the lower section of the primary flight display. When the SBL was selected beyond about 2° the display showed a green line representing the spoilers. Alerting of spoiler deployment occurred at the +5° position, where an amber warning "F/CTL SPEED BRAKES STILL EXTENDED" message would be displayed to the crew with an amber "master caution" indicator and an associated aural master caution (single chime). As the SBL in this event was only moved to the +3.6° position, the green line display would have been visible, however a warning was not activated.

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.

Airbus Industrie

As a result of this occurrence, Airbus Industrie, advised the ATSB that they are taking the following safety actions:

Ongoing work

To reduce the likelihood of a reoccurrence of the event, Airbus plans to reduce the alerting position of the speed brake lever angle from +5° to +2.4°.

Airbus have also updated the standard operating procedures (SOP) to highlight that spoiler extension may occur without a crew alert.

AO-2011-084: VH-YFE, Operational non-compliance

Date and time:	19 July 2011, 1026 EST	
Location:	39 NM (72 km) SE of Mackay Airport, Queensland	
Occurrence category:	Incident	
Occurrence type:	Operational non-compliance	
Aircraft registration:	VH-YFE	
Aircraft manufacturer and model:	Boeing Company 737-81D	
Type of operation:	Air transport – high capacity	
Persons on board:	Crew – 6	Passengers – 162
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 19 July 2011, a Virgin Australia operated Boeing Company 737-81D aircraft, registered VH-YFE (YFE), departed Brisbane on a scheduled passenger service to Mackay, Queensland, under the instrument flight rules (IFR). The First Officer (FO) was designated as the pilot flying for the flight.

Prior to commencing the descent, and while operating in Class C airspace[1], the crew conducted an approach brief, checking their predicted altitudes for the control area (CTA)[2] steps in the aircraft's flight management computer (FMC) and referencing the 'range rings'[3] on the navigation display.

At that time, the crew were aware of a preceding slower aircraft about 2,000 ft below them. After overtaking that aircraft, at about flight level (FL)[4] 250 and 96 NM from Mackay, the crew were issued with a clearance by air traffic control (ATC) to descend to 6,000 ft, at their 'best speed' (high speed descent), for traffic sequencing.

The descent was conducted using the vertical navigation (VNAV) 'speed' mode[5].

The Captain then reviewed YFE's predicted altitudes[6] at the CTA steps (Figure 1) in the FMC, to assess the effect of the high speed descent. The Captain concluded that the CTA lower limits (LL) would not be infringed. The FO did not recall the Captain reviewing the predicted altitudes nor if a brief for the high speed descent was conducted[7].

The FO then removed the range rings from the navigation display to reduce visual clutter. The FO

1 Aeronautical Information Package (AIP) ENR 1.4 paragraph 2.1.2, stated: In Class C airspace, all flights are provided with an air traffic control service, and IFR flights are separated from all other aircraft.

2 AIP ENR 1.4 paragraph 1.2.1: A controlled airspace extending upwards from a specified limit above the earth.

3 Refer to section 'Flight management computer'.

4 A flight level (FL) is a standard nominal altitude of an aircraft, used over 10,000 ft in Australia and denominated in up to three digits that represent hundreds of feet (FL 250 equates to 25,000 ft).

5 The VNAV system provides vertical profile guidance to the aircraft. A VNAV descent can be performed in either the 'path' or 'speed' mode. The speed mode maintains a target speed selected in the aircraft's FMC. While this mode attempts to comply with waypoint altitude restrictions, it will not guarantee the aircraft reaches an altitude restriction at the required point. The path mode complies with waypoint altitude restrictions by following the calculated vertical path. There is no specific guidance for determining what mode to use during a descent as each mode can be used for different purposes.

6 Refer to section 'Flight management computer'.

7 While there was no requirement to conduct an additional brief, the operator did note that, when limiting steps are involved, it may be practical and good crew resource management to discuss the situation so that a shared mental model can be maintained.

subsequently requested the range rings be reinstated on two occasions during the descent to provide increased awareness of the CTA steps.

The high speed descent was continued and YFE became low on profile (that is, the aircraft was tracking lower than the normal descent path). When about 39 NM (distance measuring equipment (DME)[8]) from Mackay, at 1026 Eastern Standard Time[9], YFE descended below the 8,500 ft lower limit of the CTA step. As a result, the aircraft departed Class C and entered Class G airspace[10] for 2.9 NM and 32 seconds, before re-entering Class C. The required clearance to depart and to re-enter Class C airspace was not obtained from ATC; however, ATC still provided YFE with separation from other aircraft during that time.

The Captain realised that they were low on profile and advised the FO, who reduced the aircraft's rate of descent. The flight continued without further incident. No other aircraft were affected by the event.

When at 36 NM (DME), the Captain later recalled they had descended to about 8,000 ft, while the FO recalled it was 7,500 ft. A review of Airservices Australia radar data indicated that the aircraft descended to about 7,700 ft.

Control area (CTA) steps

Figure 1 details the CTA steps for Mackay. The lower limit of the Class C CTA step between 36 DME and 45 DME was 8,500 ft; below this, the airspace was classified as Class G, non-controlled, airspace.

The Aeronautical Information Package ENR 1.1 paragraph 3.12 stated that:

> A pilot, desiring to retain control area protection during climb or descent in Class C or Class D airspace, should maintain at least 500 ft above the lower limit of the CTA steps.

Aircraft flight management computer (FMC)

The aircraft FMC allows crews to receive predicted information about a user-defined position, based on a distance and/or radial (bearing) from a designated point (fix) such as an airport, navigation aid or waypoint. The FMC will display the estimated time of arrival, distance-to-go, and predicted altitude where that position intersects the flight planned route. The position distance from the fix is presented on the navigation display as a dashed green circle (range ring).

For the incident flight, the crew had entered a distance to the CTA steps from the Mackay very high frequency omnidirectional radio range (VOR)[11] (fix) into the FMC. The FMC then calculated the predicted altitude at which point each CTA step distance would intersect their flight planned route. The range rings for the CTA steps then appeared on the navigation display. This assisted the crew with determining if the aircraft would remain in Class C airspace during the descent.

Operator's investigation findings

The aircraft operator conducted an internal investigation into the incident and determined that the crew's reduced situation awareness of the aircraft's descent profile and proximity to the CTA steps may have been affected by:

- the removal of the range rings on the navigation display
- the apparent exclusion of a brief for the high speed descent
- the descent being conducted in the *VNAV speed* mode rather than the *VNAV path* mode
- both crew members reported feeling tired, which may have degraded their performance.

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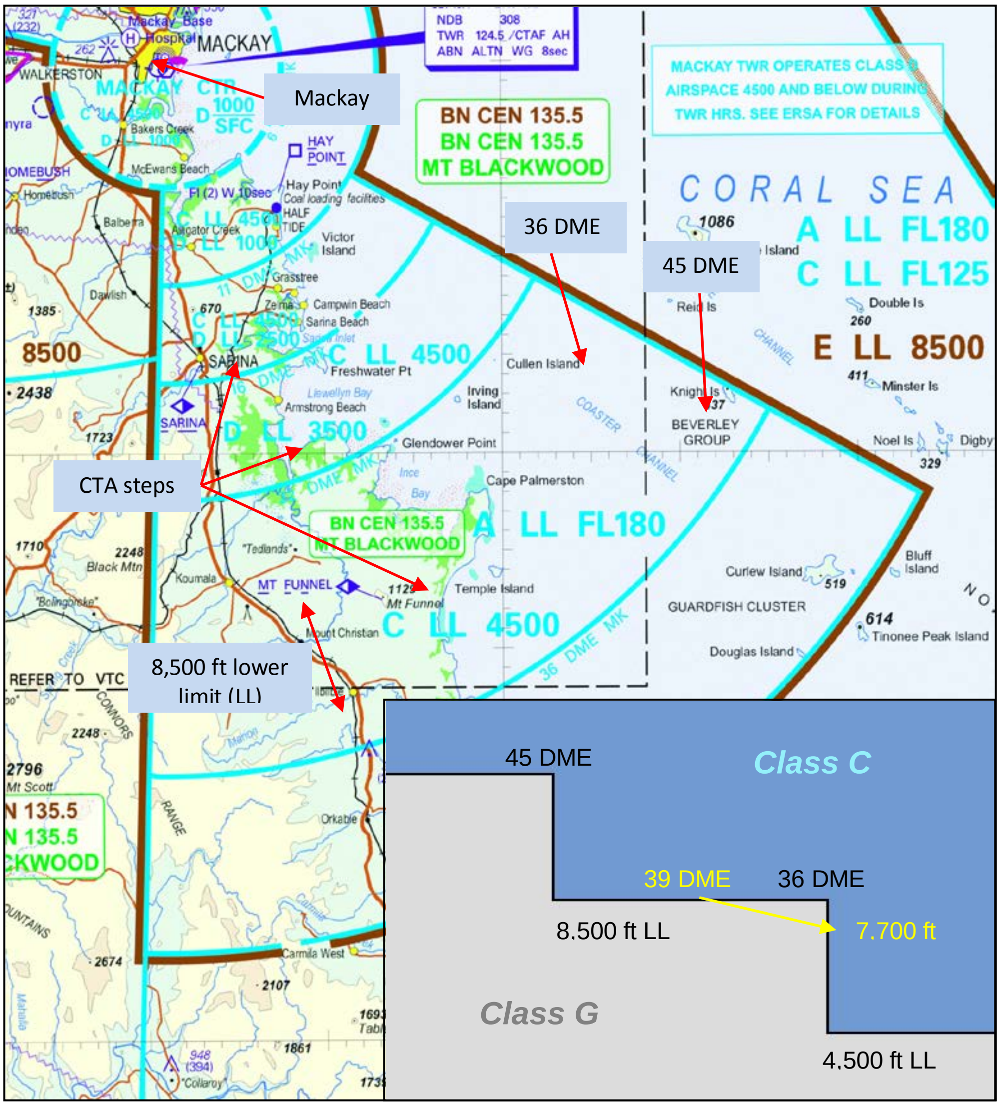
8 Distance measuring equipment (DME) is a ground-based transponder station. A signal from an aircraft to the ground station is used to calculate its distance from the ground station.

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

10 Class G airspace is non-controlled airspace; ATC separation is not provided to aircraft.

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

Figure 1: Mackay CTA steps and aircraft's approximate vertical profile (yellow)



© Airservices Australia (Mackay CTA steps)

SAFETY MESSAGE

According to the Flight Safety Foundation, the incorrect management of an aircraft's descent-and-approach profile may result in a loss of situation awareness, which in turn increases the risk of approach-and-landing occurrences.

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 so that potential issues can be identified and actioned, before they escalate[12].

This incident highlights the effect reduced situation awareness can have on aircraft operations and the importance of using all available resources, including instruments and charts, to assist with monitoring the descent profile.

The Flight Safety Foundation publication can be accessed at:

- Descent-and-Approach Profile Management www.flightsafety.org/files/alar_bn4-1-profilemgmt.pdf

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12 Flin, R., O'Connor, P. & Crichton, M. (2008). *Safety at the sharp end: A guide to non-technical skills*. Surrey: Ashgate Publishing.

AO-2011-130: VH-INT, Flight control system event

Date and time:	6 October 2011, 1700 WST	
Location:	Perth, Western Australia	
Occurrence category:	Incident	
Occurrence type:	Flight control system event	
Aircraft registration:	VH-INT	
Aircraft manufacturer and model:	Cessna 550 Citation	
Type of operation:	Aerial Work	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew –Nil	Passengers – Nil
Damage to aircraft:	Minor	

FACTUAL INFORMATION

On 20 September 2011, a Cessna Aircraft Company 550 Citation II aircraft (Figure 1), registered VH-INT (INT), was involved in a ground towing accident at Perth Airport, Western Australia when a Fokker F100 under tow collided with the tail of the stationary Citation. The collision resulted in damage to the Citation's left elevator, rudder and rudder trim control surfaces that necessitated its undergoing repairs.

On 6 December 2011, following those repairs, INT was prepared for a training flight by an instructor pilot who assumed the role of pilot in command (PIC) and a pilot undergoing conversion to type, who was the pilot flying (PF). The PIC reported that, while no formal process was in place to conduct a post-maintenance check flight, the intention was to carry out handling checks, and then proceed on a training flight.

An engineer and both crew members reported that they manipulated the primary flight and trim controls and verified full and free range of movement as part of their pre-flight inspections.

Figure 1: Cessna 550 Citation II

Photograph courtesy Cessna Aircraft Company

The PIC stated that he conducted a short portion of the initial taxi and, when satisfied, handed control over to the PF in preparation for takeoff.

The PF reported that the aircraft was hard to steer while taxiing out for takeoff and required differential braking. It was particularly hard to turn left.

The flight departed Perth at 1700 Western Standard Time[1]. Shortly after becoming airborne, the PF stated that the required elevator input appeared to be abnormally heavy, which became more noticeable as the speed increased. A low frequency buffet could be felt through the rudder pedals as the aircraft speed increased through

[1] Western Standard Time (WST) was Coordinated Universal Time +8 hours.

150 kts. The buffet continued to increase up to the maximum flight speed of 190 kts.

The PIC reported that he thought the flight appeared normal until the yaw damper and autopilot were engaged. He then noticed the balance ball[2] 'was out to the right by about 5 degrees'. He then tried using rudder trim to centre the ball but found that the trim system was jammed.

The PIC then disengaged the autopilot and yaw damper, assumed control of the aircraft and flew it manually back to Perth. The PIC confirmed the airframe buffet which the crew agreed was probably rudder flutter[3]. The crew applied pressure to either rudder pedal and noted it had no affect on the buffet, as that control axis appeared to be jammed. Suspecting the yaw damper might still be engaged, it was rechecked and confirmed to be OFF.

Although the vibration continued, the aircraft was considered by the PIC to be controllable and the aircraft was landed safely.

After landing, the PIC found there was no nose wheel steering and so had to use differential braking to turn. After engine shut down, the PIC rechecked the rudder trim, which appeared to be still jammed.

Pilot information

The pilot in command held an Air Transport Pilot's Licence (ATPL) with multi engine command instrument rating (MECIR) and had accrued 8,500 hours total flying time with 1,100 hours on the Citation.

The pilot under training also held an ATPL and MECIR with 15,500 hours total flying time. This was his first flight in the Citation.

Aircraft post-flight inspection

Examination of the aircraft identified a misalignment between the lengths of the upper and lower rudder trim tab push rods which connected the rudder trim jack to the rudder trim tab. The jam experienced by the flight crew was attributed to the discrepancy between the lengths of the two push rods.

A review of the maintenance documentation covering the repairs carried out to the rudder control surface prior to the incident flight revealed that the rudder control surface was not statically balanced[4] after repair and prior to re-fitment to the aircraft.

Although called for in the aircraft maintenance manual, it appeared that no actual rig travel check was performed on the rudder trim system after replacement of the tab.

The maintenance organisation considered that an out of balance surface had induced the rudder control system vibration felt by the flight crew.

The yaw damper and autopilot were re-engaged on the ground. The engineer stated that he then applied a light force to the rudder pedals and immediately heard a loud bang in the rear fuselage. Upon investigation, a rudder trim actuator control cable was found to have failed.

A metallurgical examination of the cable conducted by the Australian Transport Safety Bureau (ATSB) revealed that the cable had failed through a combination of fatigue and overstress (Figure 2). While there was some evidence of pre-existing wear or fraying (Figure 3), this was considered normal.

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[2] During a co-ordinated turn, in which controls about all three axes are used to avoid a slip or skid, the balance ball is centred within the instrument. The ball would also be centred in constant heading balanced flight.

[3] The high frequency oscillation of structure under interaction of aerodynamic and aero elastic loads.

[4] Control surface condition in which, in the absence of any applied torque, the surface is freely balanced about its hinge axis, either because the centre of gravity lies on that axis or because mass balance has been added.

Figure 2: Overstress and fatigue fractures

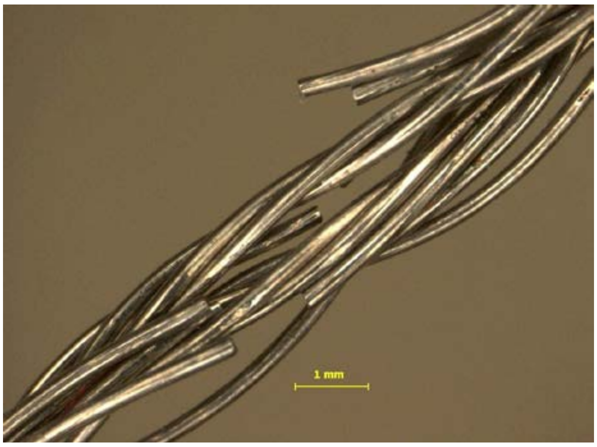
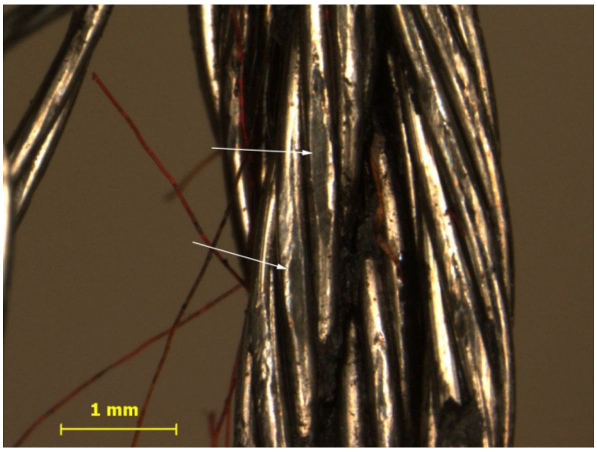


Figure 3: Abrasion wear on cable strands



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.

Maintenance organisation

The maintenance organisation conducted an internal investigation and identified several processes that were either not followed correctly or were ambiguous.

The following action was taken:

- Clarification of ambiguous wording in the Quality Instruction covering compliance with CAR 42G certifications.
- Counselling, retraining and re-assessment of the engineering staff.
- An independent review of the organisation's project management process, specifically focused on work breakdown (stages of maintenance) and level of detail recorded in work packages.
- All work packages to be audited by head office till further notice.

Operator

While there was no clear requirement or guidelines for a check flight, the operator has subsequently implemented changes to the Company Operations Manual. The change incorporates the following:

Aircraft shall undertake a proving flight (non-commercial, or non-training) after the following maintenance events:

- After an Engine change. (Double engine changes shall be conducted VFR day)
- After any major damage to the aircraft.
- After any serious unscheduled event (lightning strike, severe turbulence etc.)
- After any flight controls have been renewed, or repainted.

The aircraft shall be under the command of a Senior Captain, with a Captain/Co-pilot rated on type.

The flight shall include a representative cruise speed at altitude to allow any non normal conditions to manifest.

SAFETY MESSAGE

Maintenance

This incident highlights the importance of practising high vigilance in any maintenance tasks involving critical flight systems such as flight controls. Adherence to defined maintenance procedures will ensure all tasks are accomplished in accordance with approved data and all checks and tests are completed properly prior to release to service. A robust System of Maintenance and adherence by all personnel to it and the regulatory requirements for such activities, should assure the quality of the work completed.

The Civil Aviation Regulation 42G, *Flight control systems: additional requirements,* provides information on the maintenance requirements to be complied with for aircraft flight control systems. The regulation confirms that an inspection of flight control systems must include a check for correct function.

www.comlaw.gov.au/Details/F2011C00378/Html/Volume_1#_Toc296934324

Post maintenance check/acceptance flight

While not a requirement of the aircraft maintenance manual or the operator's Company Operations Manual, a check/acceptance flight was undertaken post major maintenance. On this occasion however, a non-type rated pilot was designated pilot flying and conducted the taxi out and departure.

Until confirmation of satisfactory aircraft handling has been made, it may be prudent for operators to restrict such flights to experienced type-rated pilots prior to any other flight or training activity being undertaken.

AO-2011-137: VH-OEH, Jetblast Occurrence

Date and time:	14 October 2011	
Location:	Brisbane Airport, Queensland	
Occurrence category:	Accident	
Occurrence type:	Jetblast	
Aircraft registration:	VH-OEH, VH-VUM	
Aircraft manufacturer and model:	Boeing 747-438 , Boeing 737-800	
Type of operation:	Air transport –high capacity,	
Persons on board:	747 Crew - 13	Passengers – 178
	737 Crew - 1	Passengers – Nil
Injuries:	747 Crew – Nil	Passengers –Nil
	737 Crew - 1 (Serious)	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 14 October 2011 at 0950 Eastern Standard Time[1], a Boeing Company 747-400 aircraft, registered VH-OEH (OEH), operated by Qantas Airways, taxied for departure from Brisbane Airport, Queensland, on a scheduled passenger flight to Sydney, New South Wales. The flight was originally scheduled for departure at 0630, but had been delayed.

OEH had been instructed by Brisbane Ground Air Traffic Control (ATC) to hold at taxiway Charlie 9 (C9) short of taxiway Bravo. The holding point for taxiway C9 was directly in line with parking bay 76B on the international apron (Figure 1). A Boeing Company 737-800 aircraft registered VH-VUM (VUM) operated by Virgin Australia, was parked at gate 76B at the time.

The flight crew of VUM were preparing the aircraft for a flight to Denpasar, Indonesia. The First Officer (FO), who was tasked with calculating the fuel required for the flight, went to communicate this figure to the aircraft refueller on the apron.

The First Officer exited VUM via the rear left door and stepped onto the push stairs. At the same time OEH was cleared by Brisbane Ground to turn left into taxiway Bravo. The pilot of OEH applied power to initiate the aircraft forward movement, producing a jetblast[2]. The push stairs at the rear of VUM were blown over by that jetblast. The First Officer standing on the stairs fell to the tarmac, sustaining serious injuries.

Jetblast

Many manufacturers provide information on predicted velocities and safe distances from jet engine exhausts. Figure 2 illustrates the predicted jet engine exhaust velocity for a 747-400ER at breakaway[3] thrust with 1.5% pavement upslope.

The distance from the rear of a Boeing 747 at taxiway C9 hold point, to the rear of a Boeing 737 parked at bay 76B was approximately 71 m.

Push stairs

The push stairs used at the rear of VUM were manufactured in accordance with Australian Standard 1657-1992 and were approved for use on the Boeing 737-800 aircraft.

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

2 Disturbance caused by ground running jet engine.

3 Breakaway thrust – Engine power needed to initiate movement and reach taxiing speed.

Figure 1: Parking Bay 76B and Taxiway C9

Photo courtesy of Virgin Australia

The stairs were free standing with two fixed wheels at the rear and two caster wheels at the front. Once in position, locking pads were manually lowered to each wheel to prevent free movement of the stairs.

The stairs had been tested at manufacture and demonstrated stability at up to 50 kts (93 km/h) wind speeds with locking pads applied.

The investigation was not able to establish if the locking pads on the stairs were correctly applied at the time of the accident.

Weather

The recorded weather conditions at 0950 EST at Brisbane International Airport were wind from the south-south east at 5 kts, gusting 6 kts. The temperature was 21.7° C.

Recorded data

Closed circuit television (CCTV) footage of the accident was reviewed by the Australian Transport Safety Bureau (ATSB). Footage of the apron at the time of the accident was available from two separate cameras located at different locations. One of the camera recordings contained an interruption at the time of the accident. The second camera footage showed the First Officer exiting the aircraft and the stairs toppling over.

Data from OEH's flight data recorder was reviewed by the ATSB, to determine the breakaway thrust used during the taxi. The average engine low pressure compressor speed (N1), and aircraft ground speed, were compared to data from four previous flights. Figure 3, shows a graphical representation of the values obtained with the purple and light green traces representing this occurrence:

- Purple trace - pushback and taxi to holding point C9
- Light green trace - clearance to turn left into taxiway Bravo from holding point C9.
- Comparative N1 and ground speeds used on previous flights are represented as red, blue yellow and dark green traces.

The peak N1 used to breakaway from the C9 hold point on this occasion was considerably higher when compared to the previous flights in the same aircraft.

Power requirements

The engine power needed to initiate movement and reach taxiing speed is influenced by a number of factors including aircraft weight, the gradient of the surface, radius of any turns required and wind speed and direction.

On this occasion OEM was relatively lightly loaded, with a takeoff weight of 234,417 kg compared to a maximum takeoff weight of 412,769 kg. That takeoff weight was the lightest compared to the other flights depicted in figure 3.

There was a 26 cm increase in height from the taxiway C9 holding point to the centreline of taxiway Bravo intersection. Data on the slope of the surface on the other flights depicted in Figure 3 was not available.

Figure 2: Jet Engine Exhaust Velocity Contours

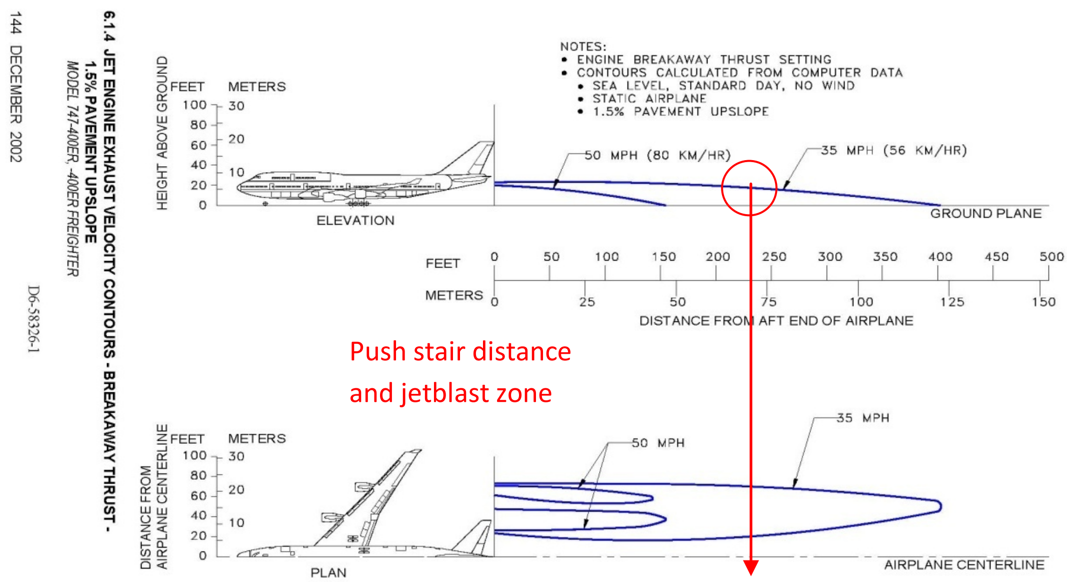


Image courtesy of Boeing

Other jetblast incidents at Brisbane Airport

Brisbane Airport Corporation (BAC) advised that on average, there were between 90 and 100 aircraft movements on the international apron in a 24 hour period. An average of three aircraft used bay 76B in any 24 hour period.

June 2008

The ATSB were aware of one other jetblast occurrence on bay 76B, in June 2008. That occurrence was in similar circumstances to the above, however no one was injured.

At that time bay 76B was being utilised by a different operator. That operator was concerned that the Civil Aviation Safety Authority's (CASA) *Manual of Standard,* for airport design was based upon pilots using no more than 40% thrust to break away, and there was no guarantee that this limit would be adhered to. Possible relocation of the C9 taxiway holding points was discussed with Airservices Australia. However an agreement could not be reached. The operator undertook a risk assessment and determined that the risk could be managed by issuing a safety notice requiring ground staff to take cover from jetblast whenever an aircraft was taxiing out via taxiway C9.

Subsequent jetblast incident

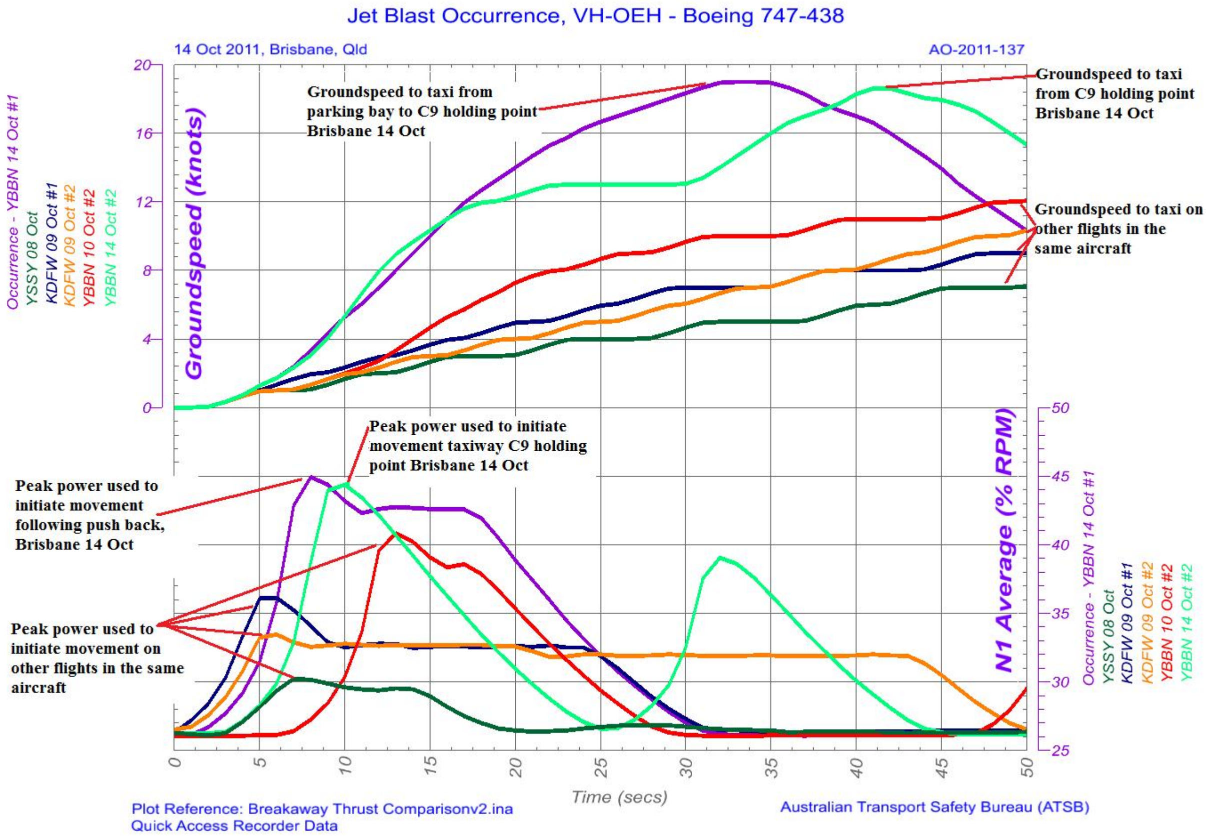
Subsequent to this accident, on 23 October 2011 at 0720 EST. an Airbus Company A320 aircraft, registered VH-VQZ (VQZ) and operated by Jetstar, on a scheduled passenger flight to Perth, Western Australia, had pushed back from bay 38, at Brisbane Airport, to the bay disconnect point.

At the same time, another Jetstar operated A320 aircraft, registered VH-VQQ and parked at bay 31 was disembarking passengers from the front and rear push stairs. It was reported that on taxi, as VQZ turned to face the taxiway, breakaway thrust was maintained, exposing the disembarking passengers at bay 31 to moderate jetblast.

Ground staff in the vicinity described the jetblast velocity as "more than normal" and estimated the strength as about 20 kts (37 km/h). Closed circuit television (CCTV) footage of the incident was obtained by the ATSB and examined.

On review there was no clear evidence that passengers, crew or ground handling staff were being adversely affected by the blast. Furthermore the operator's internal investigation into the occurrence determined that the maximum recorded N1 thrust used during the taxi and turn was only 27%. The flight crew operating manual stated that a

Figure 3 - Breakaway Thrust Comparison VH-OEH



maximum N1 used for taxi in the A320 was 40%. The event, however, reaffirms the importance of appropriate power settings during ground manoeuvring.

The CASA, *Manual of Standards, Part 139 – Aerodromes, at 6.6.2 Jetblast and Propeller Wash Hazards,* recommended that the maximum jet engine exhaust velocity should not exceed 32 kts (60 km/h) where passengers are expected to walk or people are expected to congregate. Where personnel are working on an aircraft the recommended maximum exhaust velocity is 43 kts (80 km/h).

SAFETY ACTION

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

Virgin Australia

As a result of this occurrence, Virgin Australia issued a Flight Crew Operation Notice advising all crew of the possibility of jet blast on Bay 76B, with the advice that the aluminium stairs shall no longer be used to access the aircraft. The aircraft will now be accessed by a high lift truck and the aerobridge.

Brisbane Airport Corporation (BAC) and Airservices Australia

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

Immediate response

Airservices Australia have issued a Notice to Airmen[4] (NOTAM) at the request of BAC making the

4 A Notice To Airmen advises personnel concerned with flight operations of information concerning the establishment, condition or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to safe flight.

intermediate holding points on taxiways Charlie 9 and Charlie 10 unavailable. Further all aircraft vacating the international apron are required to do so without stopping and using minimum power on the taxiways.

Further response

BAC have advised that they will investigate the viability of intermediate holding points being established on the international apron on both sides of taxiway Charlie 9 and Charlie 10. This would direct any potential jetblast away from the parking bays.

Alternatively, following the completion of taxiway Charlie 8, BAC will investigate the feasibility of having taxiway Charlie 9 as an entry on to the international apron only.

SAFETY MESSAGE

Ramp safety is one of the understated risks for passengers, cabin crew and ground personnel, especially with the increase in the number of parking bays located remote from aerobridges.

Every airport is unique and cabin crew and ground personnel need to maintain their vigilance[5]. Situational awareness is the best defence against accidents on the ramp. Ground personnel and cabin crews need to develop an awareness of other aircraft activity in their vicinity and direct passengers accordingly.

This accident also serves as a reminder to pilots of the real danger posed by jetblast. The level of thrust utilised during ground operation requires sound judgment and technique. Even at relatively low power settings, the blast effect from large modern high bypass turbine engines can be destructive and may cause injury to those nearby.

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[5] Cabin Crew Ramp Safety, *Flight Safety Australia July-August 1999 pg49* *www.casa.gov.au/wcmswr/_assets/main/fsa/1999/jul/fsaramp.pdf*

AO-2011-114: VH-VAQ, Aircraft handling event

Date and time:	13 September 2011, 1340 CST
Location:	Darwin Airport, Northern Territory
Occurrence category:	Incident
Occurrence type:	Loss of control
Aircraft registration:	VH-VAQ
Aircraft manufacturer and model:	Raytheon Aircraft Company 1900D
Type of operation:	Aerial work
Persons on board:	Crew – 3 Passengers – Nil
Injuries:	Crew – Nil Passengers – Nil
Damage to aircraft:	Nil

FACTUAL INFORMATION

On 12 September 2011, a Raytheon Aircraft Company 1900D (Beech 1900), registered VH-VAQ (VAQ) and operated by Vincent Airlines, departed Darwin Airport, Northern Territory on a local training flight (Figure 1). On board were a check captain, a check captain under training and a first officer (FO).

The purpose of the flight was to conduct a proficiency check in preparation for the FO to be checked to line operations. The check captain and the FO met prior to the flight to discuss the planned flight. The FO understood that a number of asymmetric exercises would be conducted during the flight, including a simulated engine failure after V_1 on departure[1].

At about 1330 Central Standard Time[2], the flight crew taxied the aircraft for runway 11 at Darwin Airport. The check captain requested a clearance for simulated asymmetric operations on departure, which was granted by Air Traffic Control. The FO, seated in the right seat, assumed the role of pilot flying, while the check captain, in the left seat, operated as the pilot monitoring. The check captain under training was seated in the first passenger row.

The take-off roll was normal and the FO rotated the aircraft at the appropriate V_1/V_R[3] speed. The FO recalled that just after rotation he noticed that the aircraft was slightly out of trim in the yaw axis. He deflected the left rudder and readjusted the trim. He later commented that he would normally wait until he was at a higher altitude before performing this task if required and was unsure why he had not delayed the adjustment on this occasion.

About one second after becoming airborne, at 108 kts and an estimated 80 ft above ground level, the check captain announced "simulating engine failure" and reduced the left engine power setting to just above zero thrust. The FO recalled feeling left rudder pedal pressure under his foot and instinctively depressed the left rudder pedal. The FO recalled seeing the aircraft yaw and roll to the left of the runway and trees appear ahead of the aircraft. He did not recall carrying out any actions to identify the failed engine.

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

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

3 V_1 and V_R were the same speed for this aircraft. V_R is the speed at which the rotation of the aircraft is initiated to takeoff attitude. This speed cannot be less than V_1 or less than 1.05 times V_{MC} (the minimum control speed of an aircraft with its critical engine inoperative). V_R must also allow for acceleration, despite an engine failure, to V_2 at a height of at least 35 feet height by the end of the runway.

The check captain felt the control column touch his left hand, which was the opposite control input to what he expected. He observed that the aircraft had diverged left of centreline and was in about a 15-20° left level turn. The check captain took over the role of pilot flying and announced “taking over”. The FO replied “handing over” and released the controls. The check captain applied right rudder, reduced the roll to the left and increased the power on the left engine while simultaneously reducing the power slightly on the right engine. The aircraft was established in a climb and reconfigured for a normal two-engine departure. The check captain conducted a circuit and landed VAQ back at Darwin Airport.

Recorded information

Flight Data Recorder

The flight data recorder was removed from the aircraft for download and analysis by the Australian Transport Safety Bureau. The data indicated that the simulated engine failure occurred about one second after rotation. Power was restored on the left engine about five seconds after the simulated engine failure. A positive rate of climb was established eight seconds after takeoff.

Shortly after the simulated engine failure, the aircraft banked to the left, reaching a maximum of 10° left bank. The aircraft heading reached a maximum deviation of 25° to the left of the runway heading.

Rudder Boost System

The aircraft was equipped with a rudder boost system that sensed engine torque from both engines. When the torque differential between the engines exceeded 1200 lb, the rudder boost electric servo activated and deflected the rudder to aid pilot effort. The servo contribution increased in proportion to the increase in torque differential resulting from the loss of power from an engine.

Following the event, the FO believed that the upward pressure he felt from the left rudder pedal was due to the normal operation of the rudder boost system deflecting the right rudder during the simulated engine failure.

Training

Simulated engine failure procedures

The operator’s procedure for simulating an engine failure stated that the failure should occur at not less than V_1 speed.

The Flight Manual stated that intentional in-flight engine cuts should be conducted by retarding the power lever to zero thrust at or above the V_{SSE}[4] speed of 105 kts.

Previous training.

The FO had conducted two recent simulated engine failures on departure. He had also performed the procedure about three times during his endorsement and initial line training, nine months previously. Both the FO and the check captain reported that the FO had not experienced any problems performing the required actions and checks during previous training exercises.

ATSB COMMENT

CASA - Notice of Proposed Rule Making (Project OS 09/14)

The Civil Aviation Safety Authority (CASA) issued a Notice of Proposed Rule Making (Project OS 09/14) in October 2010 to address the possibility of making simulator training mandatory for all non-normal exercises. The proposed changes would make it compulsory for aircraft certified to carry 20 or more passengers to conduct non-normal exercises in a simulator or flight training device if one exists. For aircraft that seat between 10 and 19 passengers the requirement will apply only if the simulator is available within Australia. CASA is currently undertaking a full impact assessment of the proposal and anticipates producing draft amendments following further consultation with industry towards the end of 2011.

4 V_{SSE} is the minimum safe single-engine speed, selected by the manufacturer, for intentionally shutting down one engine in flight for pilot training.

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.

Vincent Aviation

Simulator training

The operator has actively pursued the establishment of a Beech 1900 simulator in the Australasian region. Currently the closest Beech 1900 simulator is in Toronto, Canada. The operator is hopeful that an appropriate simulator will become available in the region in the near future, and will endeavour to use the simulator for non-normal training.

SAFETY MESSAGE

Simulated engine failure training, especially at low altitude, continues to present a risk to flight crew during training exercises. The Flight Safety Australia article *Even worse than the real thing* provides a useful oversight of the hazards associated with conducting simulated engine failures after takeoff. The article highlights that more engine failure after take-off (EFATO) accidents occurred as a result of simulated EFATO events then were caused by genuine engine failures. The article also provides a detailed overview of conducting asymmetric training in turboprop aircraft.

Even worse than the real thing (2002) Flight Safety Australia, March-April

www.casa.gov.au/wcmswr/_assets/main/fsa/2002/mar/30_35.pdf

The ATSB has recently completed an investigation into a fatal accident involving a Brasilia, registered VH-ANB, in Darwin on 22 March 2010. The investigation found that the crew were performing a simulated engine failure after takeoff, from runway 29 for the purpose of revalidating the captain's command instrument rating. The investigation final report can be found on the ATSB's website at the following link:

- Collision with terrain – VH-ANB, Darwin Aerodrome, Northern Territory, 22 March 2010
  www.atsb.gov.au/publications/investigation_reports/2010/aair/ao-2010-019.aspx

The ATSB has also conducted a number of investigations into events during simulated engine failure exercises.

Investigation BO/200000492 examined a simulated engine failure on take-off incident involving a Beech 1900 at Williamtown, NSW in 2000. Following the incident, the ATSB recommended that CASA publish information for the guidance of operators and pilots regarding the correct procedures for simulating engine failures in turbo-propeller aircraft. This was provided in CAAP 5.23-1(1)

The complete investigation report can be found at the following link:

BO/200000492 One-engine inoperative training – failure to achieve predicted performance – VH-NTL, Williamtown Aerodrome, NSW, 13 February 2000

www.atsb.gov.au/media/24342/aair200000492_001.pdf

ATSB (formerly BASI) investigation 9503057 examined a fatal accident following a simulated engine failure at V_1 at night. The complete investigation report can be found at the following link:

9503057 (BASI) Fairchild Aircraft Model SA227-AC - VH-NEJ, Tamworth, NSW, 16 September 1995

www.atsb.gov.au/media/24977/aair199503057_001.pdf

Figure 1: Beech 1900 aircraft, VH-VAQ

Image courtesy of the operator.

AO-2011-101: VH-OCM, Fuel starvation

Date and time:	18 August 2011	
Location:	Kununurra aerodrome, Western Australia	
Occurrence category:	Accident	
Occurrence type:	Collision with terrain	
Aircraft registration:	VH-OCM	
Aircraft manufacturer and model:	Cessna aircraft Company 210N	
Type of operation:	Charter – passenger	
Persons on board:	Crew – 1	Passengers – 5
Injuries:	Crew – 0	Passengers – 1 Minor
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 18 August 2011, at 0755 Western Standard Time[1], a Cessna Aircraft Company 210N (C210) aircraft, registered VH-OCM (OCM), departed Mitchell Plateau, Western Australia, on a charter flight to Kununurra under the visual flight rules. On board were the pilot and five passengers.

Prior to departure, the pilot conducted a pre-flight inspection that included dipping the fuel tanks to establish the fuel quantity. The pilot recorded 90 L in the left tank and 65 L in the right tank. Each passenger was weighed together with their luggage and loaded.

The pilot completed a normal take-off and climbed to a cruise altitude of 5,500 ft above mean seal level (AMSL). At about 28 NM from Kununurra aerodrome the pilot commenced descent for a straight in approach to runway 12.

At 5 NM from the runway threshold and at 1,700 ft, the pilot reduced engine power and selected 10° flaps and the fuel mixture to rich. At 3 NM from the runway threshold, the pilot further reduced engine power, lowered flaps to 20°, then shortly after to 30° and commenced the pre-landing checks. At that moment the aircraft encountered wind gusts. The pilot reduced the flaps to 20°, but OCM began to sink below the approach profile. The pilot increased engine power to regain the approach profile, and did not complete the pre-landing checks, including selecting the fullest fuel tank for the landing.

At about 0.6 NM from the runway threshold and approximately 250 ft above ground level (AGL) engine power fluctuations began, then at 200 ft AGL, the engine lost all power. The pilot lowered the nose to maintain airspeed and carried out the memorised emergency actions (fuel mixture to rich, fuel pumps on and both magnetos on) but did not change tanks. When the engine failed to start, the pilot broadcast a Mayday[2] on the CTAF[3].

At about 0928, the pilot conducted a forced landing into an open area short of the runway threshold. During the landing, the aircraft struck a bank and was seriously damaged (Figure 1). The impact activated the emergency locator transmitter. The pilot secured the aircraft and disembarked the passengers. Only minor injury to one of the passengers was reported.

At 0925, Air Traffic Control (ATC) at Brisbane was alerted by another aircraft to the Mayday call. When no further communications were received

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

2 'Mayday' is an internationally recognised call for urgent assistance.

3 Common Traffic Advisory Frequency, the name given to the radio frequency used for aircraft-to-aircraft communication at aerodromes without a control tower.

a DETRESFA[4] was declared and ATC advised Australian Search and Rescue (AusSAR). When it was determined that the aircraft had landed and the passengers were safe, the DETRESFA was cancelled.

Pilot Information

The pilot had a total of 288.8 hours flying time with 89.4 hours on the C210. He held a commercial pilot licence and a valid Class 1 medical without restrictions. He had been endorsed on the aircraft type by the operator. The endorsement training had included practice engine failure simulations.

The pilot was suitably rested from the overnight stay at the Mitchell Plateau, having had 8.5 hours sleep. He had been on duty for 2.5 hours prior to the accident. The previous day he had been on duty for 3 hours. The pilot reported that he was not fatigued and was fit for duty.

Aircraft information

The C210 was a single-engine, 6-seat, high-wing aircraft with retractable landing gear. Its fuel system consisted of an integral fuel tank of 170 L capacity in the inboard section of each wing. A fuel selector at the base of the central pedestal, between the two front seats had three positions: LEFT–OFF–RIGHT. Fuel could be selected from either the left or right fuel tank to the engine for normal operation, or selected off, to isolate the fuel in an emergency. Two electrical fuel quantity gauges on the centre pedestal, above the fuel selector, provided a visual indication of the fuel quantity for each tank.

The manually operated fuel mixture control enabled the pilot to adjust fuel flows during flight for optimum power and economy. For landing, the mixture control was set to full RICH. Operators were required to establish fuel consumption rates for each of their aircraft and to continuously monitor those rates.

4 DETRESFA: The code word used to designate a distress phase. A situation where there is a reasonable certainty that an aircraft and its occupants are threatened by grave and imminent danger, or require immediate assistance.

The aircraft had recently been fitted with a new engine, which required increased power settings to be used during the run-in period. However, the use of power settings different from those set to establish consumption rates could result in different fuel burns.

The operator examined the aircraft following the accident and found approximately 65 L of fuel in the right wing tank and 2 L in the left wing tank. No fuel was found in the fuel lines or in the fuel filter.

Figure 1: Accident site of VH-OCM

Image courtesy of the operator.

The operator determined that the aircraft weight and centre of gravity were within prescribed limits.

Operator findings

The operator conducted an investigation that included the following findings:

- The pilot did not adequately monitor fuel levels throughout the flight nor use a fuel log.
- The pilot did not complete the Engine Failure During Flight procedure after the engine lost power. Changing fuel tanks may have restored engine power.
- The Mayday was broadcast on the Kununurra CTAF instead of the Brisbane Centre frequency, delaying emergency services response.
- The investigation also determined that the higher power settings used during the engine run-in period had resulted in higher

fuel consumption rates than the operator's standard planning rate. However, as the total fuel remaining in the aircraft tanks after the accident exceeded the minimum reserve fuel required for the flight, high fuel consumption was not considered a contributing factor in the accident.

Checklists

The operator's C210 normal checklist required a fuel quantity and tank selection check, as part of the 'pre-descent' check. The 'before landing' checklist required that the fullest fuel tank be selected. The operator also utilised the Cessna emergency procedures for engine failure during flight. These procedures required a fuel quantity check and selection of the fullest tank.

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

Standard operating procedures

In response to the accident, the operator implemented the following actions:

- An amendment to the operations manual was raised requiring all pilots to use a standardised fuel log on all flights.
- Increased block fuel flow figures will be used for flight planning during new engine run in periods.

SAFETY MESSAGE

Fuel management issues, including fuel starvation[5] and exhaustion[6], are not new in aviation, and have been a continuing safety concern for aviation authorities worldwide for many years. In Australia between 1991 and 2002, these issues accounted for 6 per cent of all accidents. The ATSB has published the following research report related to these types of events.

Australian Aviation Accidents Involving Fuel Exhaustion and Starvation (2002).

www.atsb.gov.au/publications/2003/fuel_exhaustion_and_starvation.aspx

The following ATSB investigations are just some of the more recent reports that provide further reading on fuel starvation occurrences:

200601340 - VH-JDJ, 01 June 2006,2.4 km NW of Bathurst Island Aerodrome.

www.atsb.gov.au/media/1361754/aair200603140_001.pdf

AO-2008-048 - VH-IHR, 17 July 2008, Mount Isa, Queensland.

www.atsb.gov.au/media/51177/ao2008048.pdf

AO-2010-009 - ZK-JAO, 14 February 2010, 19 km E of South West Rocks NSW.

www.atsb.gov.au/publications/investigation_reports/2010/aair/ao-2010-009.aspx

5 Fuel starvation – the state in which all the aircraft's useable fuel has not been consumed, but that fuel is not available to the engine.

6 Fuel exhaustion – the state in which all of the aircraft's useable fuel has been consumed.

AO-2011-104: VH-LAN, Engine power loss

Date and time:	23 August 2011/ 1145 CST	
Location:	Near William Creek ALA, Lake Eyre, South Australia	
Occurrence category:	Incident	
Occurrence type:	Engine power loss	
Aircraft registration:	VH-LAN	
Aircraft manufacturer and model:	Cessna Aircraft Company U206G	
Type of operation:	Charter – passenger	
Persons on board:	Crew – 1	Passengers – 5
Injuries:	Crew – Nil	Passengers - Nil
Damage to aircraft:	Minor	

FACTUAL INFORMATION

On 23 August 2011, a Cessna Aircraft Company, model U206G (C206) aircraft, registered VH-LAN (LAN), was conducting a charter flight from Olympic Dam to William Creek Aircraft Landing Area (ALA) near Lake Eyre, South Australia, with the pilot and five passengers on board. At about 1145 Central Standard Time[1], the engine lost power, resulting in the pilot conducting a forced landing onto a dry lake bed. During the landing, the aircraft nose wheel sunk into the soft ground and the aircraft nosed over with the propeller blades and left wing tip contacting the ground, then settled back onto the landing gear. There were no injuries to the occupants, who exited the aircraft without incident (Figure 1).

At the time of the power loss, LAN was at 2,000 ft above mean sea level, flying in company with eight other aircraft engaged in transporting a total of 48 tourists to the Lake Eyre region.

The pilot reported that they were about 1 hour 20 minutes into the 1 hour 40 minute flight when he heard a loud bang, felt vibration and noted a drop in fuel pressure. Any change of throttle setting exacerbated the problem.

While descending through 1,400 ft, the pilot contacted the nearest aircraft which was about 0.5 NM to the south and advised that he was

Figure 1: VH-LAN after landing

Photo courtesy of Luke Justin

conducting a forced landing. The pilot also completed emergency procedures such as selecting another fuel tank and activating the electric fuel boost pump, but the engine did not respond. He then selected an emergency forced landing area and advised the passengers of the situation.

The pilot reported that, even with full nose-up control input during the landing roll, the nose wheel broke through the soft surface and the aircraft pitched nose-down before coming to a halt (Figure 2).

At the time of the accident, LAN had about 158 L of fuel remaining. There was no previous indication of a problem, with normal engine indications for cylinder head temperature, oil temperature and oil pressure displayed.

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

After all occupants had exited the aircraft, the pilot conducted a cursory examination of the engine and noted damage to the number-4 cylinder and its associated fuel injector.

Figure 2: Aerial view of landing roll

Photo courtesy of Luke Justin

The cylinder head and the fuel injector supply line had fractured and separated. The aircraft was eventually recovered and the engine removed for further examination.

Pilot information

The pilot had accumulated about 630 hours total flying experience, with about 250 hours in the C206. His last low-level emergency procedure training was completed in February 2011. He began flying scenic flights for the operator in November 2010.

Engine information

The aircraft was fitted with a model IO-520F Continental engine, serial number 564490, that was last repaired on 13 July 2011 at 941.2 hours engine total time in service[2] (TTIS) and 8,860.5 hours aircraft TTIS. During that maintenance, all six engine cylinders were replaced with repaired engine cylinders, with 720.3 hours time since overhaul (TSO)[3].

Detailed engine examination

Disassembly and examination of the engine confirmed the failure of the number-4 cylinder. The cylinder body had cracked around the circumference in the area of the cylinder head (Figure 3).

Figure 3: Failed number-4 cylinder

Photo courtesy of the aircraft operator

A Service Difficulty Report (SDR) was submitted to the Civil Aviation Safety Authority (CASA), noting that the cylinders were manufactured by Engine Components Incorporated (ECI) and were 'non-genuine' parts[4]. Several manufacturers of non-genuine piston engine components, such as engine cylinders, exist within the industry. These components are typically approved by the US Federal Aviation Administration (FAA) Parts Manufacturer Approval process for use in aircraft engines and generally cost less than the original engine manufacturer components.

Engine cylinder background

At the time of the accident, the number-4 cylinder had accrued 790.2 hours TSO. Periodic engine cylinder differential compression checks have the potential to identify cracks in a cylinder before a structural failure. These checks are typically completed every 100 hours. The last compression check was completed on 13 July 2011 following cylinder installation with all readings within the acceptable range. No maintenance or compression checks of the engine had been completed since that maintenance.

The engine cylinders removed during the engine maintenance on 13 July 2011 were subsequently sent for repair at an authorised engine repair facility. Those cylinders had been

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2 The engine major overhaul requirement was every 12 years or 1,700 hours in service.

3 The cylinders were replaced due to excessive oil smoking of the engine.

4 Components not manufactured by the engine manufacturer but approved for use.

installed on 3 April 2009 and had accrued 941.2 hours TTIS. During the induction inspection, 2 of the 6 cylinders were found to have large cracks around the cylinder heads in a similar orientation to that of the failed cylinder. These cylinders were produced by the same manufacturer as the failed number-4 cylinder.

Engine cylinder cracking history

From 1 January 2007 to 1 September 2011, the CASA SDR database listed a total of 9 reported cracked engine cylinders for the engine model and type (520 series). Cylinder cracking failures were the subject of airworthiness directives (AD) issued by CASA and the FAA and service bulletins issued by the engine component manufacturers. CASA AD/85-006[5], issued in November 2006, noted the failure mode and cylinder separation issues with ECI manufactured cylinder assemblies on this engine model.

In addition, Australian Transport Safety Bureau (ATSB) occurrence report 199804715[6] also documented the issue of engine cylinder head cracking.

ATSB comment

While following the engine and aircraft manufacturer's maintenance requirements can reduce the likelihood of premature failure of components, a visual inspection of the cylinders for cracking is difficult with the engine installed. The failed cylinder had been visually inspected during repair and had only been in service for about one month.

An engine cylinder differential compression check had not been completed on the cylinders since the one completed directly following installation, as the stated time interval had not been reached.

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 operator has advised the ATSB that all ECI cylinders installed on company aircraft engines have been removed from service.

SAFETY MESSAGE

The pilot reacted to the emergency appropriately and was able to conduct a forced landing that resulted in no injuries to the occupants.

Understanding the possible causes of engine cylinder cracking is crucial to minimising their likelihood and consequence. One engine manufacturer attributes these failures to sudden/rapid cooling of the engine due to fast descents. This publication is available at:

www.lycoming.com/support/tips-advice/key-reprints/pdfs/Key%20Operations.pdf

A safety advisory article published by the Aircraft Owners and Pilots Association recommends:

> Piston aircraft engines are made mostly of steel and aluminium, which expand and contract at different rates, depending on temperature. When flying at varying altitudes and from one climatic zone to another, temperature changes can be extreme. By keeping large engine temperature changes over a short period of time to a minimum, and within prescribed limits, the safety, reliability and longevity of the engine are significantly enhanced.
>
> For example, avoiding rapid descents at idle power near your destination airport will help avoid "shock cooling," which is the too-rapid cooling of hot engine metals. Shock cooling causes stress that can lead to cylinder head cracks. To avoid this, begin descent planning farther out and descend at a slower rate with a low-cruise power setting.

This publication is available at:

www.aopa.org/asf/publications/sa25.pdf

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5 CASA AD/85-006.

6 Report 199804715

AO-2011-107: VH-NIW, Wirestrike

Date and time:	26 August 2011, 1545 WST	
Location:	5 km N of Mogumber, Western Australia	
Occurrence category:	Accident	
Occurrence type:	Wirestrike	
Aircraft registration:	VH-NIW	
Aircraft manufacturer and model:	Air Tractor Inc. AT-802	
Type of operation:	Aerial work	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – 0	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 26 August 2011, at about 1545 Western Standard Time[1], an Air Tractor Inc. AT-802, registered VH-NIW (NIW), struck power lines during agricultural spraying operations.

Earlier that day, at about 0700, the pilot had commenced the first of six scheduled agricultural spraying flights from a private airstrip near Mogumber, Western Australia. At mid-morning, he was approached by a farmer to carry out a seventh (unscheduled) spraying operation of wheat paddocks next to the Bindoon-Moora road. The farmer supplied the pilot with a map of the fields to spray, which included the location of two powerlines. He then loaded the aircraft hopper with the required chemical spray mix and flew to the property.

On reaching the property, the pilot commenced his field inspection. He flew north at 200 ft above ground level (AGL), following the main power line running through the property, then turned south to fly along the edge of the main road. During the inspection, the pilot identified the two powerlines and paddocks marked on the farmer's map and a third unmarked powerline. At the same time, his attention was diverted to vehicle traffic on the main road located next to the spraying area. The pilot reported that he was concerned that issues might arise from conducting spraying operations close to the traffic.

Taking advantage of a break in the traffic, the pilot manoeuvred NIW in a northerly direction, then flew below the level of the powerlines and commenced spraying operations adjacent to the main road. When about 300 m into the paddock, the aircraft struck an unseen fourth set of powerlines (Figure 1).

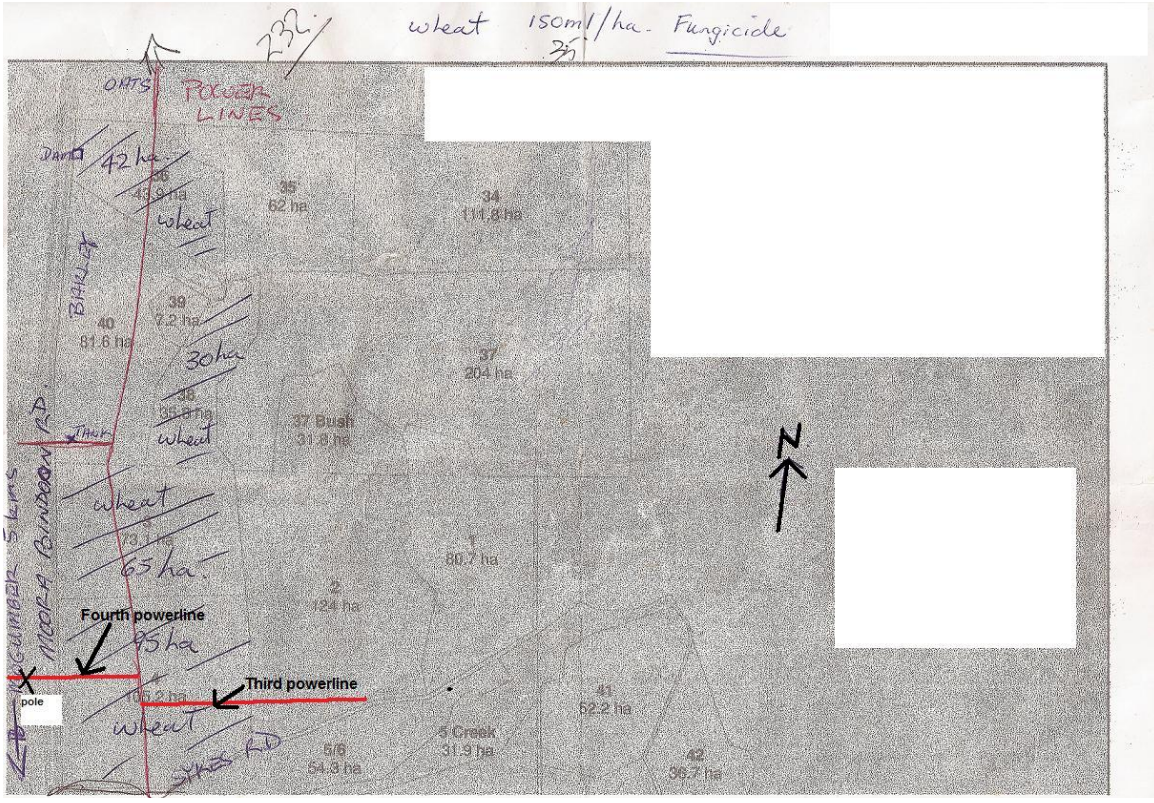
After striking the powerlines, the pilot looked to the right and saw electrical arcing from the top of the power pole. He climbed the aircraft up to treetop level, believing it had sustained only minor damage and looked for a suitable area to 'dump' the chemical spray. However, the engine lost power, forcing the pilot to immediately jettison the spray load. The aircraft then entered into an uncommanded gradual left turn, which the pilot could not correct. The aircraft, flying left wing low, continued over the main road and struck terrain in a neighbouring paddock. The aircraft sustained serious damage (Figure 2); the pilot was not injured.

Pilot information

The pilot held a Commercial Pilot (Aeroplane) Licence and a valid Class 1 medical certificate. He had a total of 12,757 hours, of which about 5,500 hours were on the AT-802.

[1] Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

Figure 1: Farmers map with added powerlines marked



Photograph courtesy of the pilot.

Pilot comment

The pilot stated that he may have become distracted by the vehicle traffic on the main road, which subsequently diverted his attention away from maintaining a lookout for powerlines.

The pilot also reported that he did not see the power pole hardware associated with the struck line or the house the line was connected to, as they were obscured by trees.

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

Operations Manual

The operator has advised that the following amendments will be made to the operations manual.

> Before entering the field to be treated, the pilot is required to fly around the entire perimeter at least twice to firmly establish the location of wires, stand pipes, or other obstacles.
>
> (a) At least one high recce is to be flown at approximately 500 ft AGL.
>
> (b) At least one low level recce is to be flown at approximately 250 ft AGL.

These amendments will take precedence over the aircraft flight manual

Operator Policy

The aircraft operator has advised that they will reinforce with pilots that the operator policy is: ‘do not fly below power line height in the Air Tractor 802 aircraft’.

SAFETY MESSAGE

Wirestrikes pose an ongoing problem to aerial agricultural operations. The joint ATSB and the Aerial Agricultural Association of Australia report, *Avoidable accidents No. 2 – Wirestrikes involving known wires: a manageable aerial agriculture hazard*, identified 180 wire strike accidents between 2001 and 2010. Of these, 100 involved aerial agricultural operations. Some of the hazards identified in the report that are associated with identification of wires and distractions are set out below.

Identification of wires

Whether operating into a known or unknown area, it is important that pilots have an up-to-date and detailed map of the area, which clearly identifies powerlines and other hazards. Some pilots of wire strike accidents reported to the ATSB that the maps provided by clients did not have the powerlines clearly marked. Conducting a thorough briefing with the property owner, local residents or other operators with experience in the area will further assist with hazard identification. However, it is important to recognise that a map or briefing alone does not tell the entire story. It is crucial that an aerial inspection of the area is conducted to confirm the locations of wires and hazards. The report further stated:

> Be aware that during the reconnaissance, you may miss spotting some wires as the visual cues are not always reliable or available. For example, power poles often blend into background vegetation, making them difficult to see. Also, don't rely entirely on the presence of poles or other cues as indicators of wires. If you can see the wire, follow the wire itself to confirm its placement.

Distractions

Multi-tasking in aerial agricultural operations is part of the job; however, focusing attention on non-operational tasks or focusing on operational tasks at the wrong time can affect hazard avoidance, detection and reaction times. Research published by the ATSB in 2006 identified 325 occurrences between January 1997 and September 2004 associated with pilot distractions, of which six per cent involved aerial agricultural operations. The Flight Safety Foundation recommends that after a distraction sources has been identified, pilots should re-establish situation awareness by applying the following:

- *Identify:* What was I doing?
- *Ask:* Where was I distracted?
- Decide/act: What decision or action shall I take to get 'back on track'?

This accident highlights the vital role hazard identification has, particularly when operating at low-level, and how distractions can impact operations. It is a reminder that distractions are not unique to any one type of operation and that no pilot is immune.

The following publications provide additional information on wirestrikes and distractions:

- *Avoidable accidents No. 2 – Wirestrikes involving known wires: a manageable aerial agriculture hazard* www.atsb.gov.au/media/2487114/ar2011028.pdf
- *Wire-strike accidents in General Aviation: Data Analysis 1994 to 2004* www.atsb.gov.au/media/32640/wirestrikes_20050055.pdf
- *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

Figure 2: Accident site of VH-NIW

Image courtesy of the owner/operator.

AO-2011-118: VH-HCE, Total power loss

Date and time:	26 September 2011, 0858 EST	
Location:	Bankstown Airport, New South Wales	
Occurrence category:	Accident	
Occurrence type:	Total power loss	
Aircraft registration:	VH-HCE	
Aircraft manufacturer and model:	Cessna Aircraft Company, 152	
Type of operation:	Flying training - dual	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

At 0835 Eastern Standard Time[1] on 26 September 2011, a flight instructor and student pilot in a Cessna Aircraft Company 152 registered VH-HCE (HCE), were operating at Bankstown Airport, New South Wales, on a training flight.

The student was in the early stages of obtaining a private pilot licence. The instructor planned on demonstrating a series of rejected takeoffs followed by circuits encompassing emergency procedures.

Pre-flight checks

Pre-flight checks were completed with the instructor obtaining a combined sample of fuel from both wing tanks and the fuel strainer. The instructor showed the combined sample to the student with both agreeing that the sample looked and smelt normal with no impurities present. The engine run-up was conducted with no problems identified.

Pre-accident

The instructor obtained clearance from air traffic control (ATC) to conduct a series of practice rejected take-offs on runway 11/29 centre. Once satisfied that the student had demonstrated the learning outcomes, the instructor obtained circuit clearance from ATC, departing from runway 11 centre for circuits to runway 11 right.

The student conducted the initial circuit before handing control to the instructor who demonstrated a go-around[2]. The instructor then demonstrated a glide circuit before handing control back to the student to complete the approach and touch-and-go[3]. The student completed this procedure and the aircraft became airborne approximately two thirds distance from the runway 11 right threshold.

Engine power loss

At an altitude of approximately 200 ft above ground level, the instructor heard the engine noise reducing and observed the engine RPM decreasing. The instructor immediately assumed control and lowered the nose of the aircraft to maintain airspeed.

With engine power further reducing, the instructor determined that ability to land on the remaining runway was restricted and identified a

1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10.0 hours.

2 A procedure for discontinuing an approach to land. A go-around is a standard manoeuvre performed when a pilot is not completely satisfied that the requirements in place for a safe landing have been met.

3 Landing practice where an aircraft does not make a full stop after a landing but proceeds immediately to another take-off.

clear grassed area at his 10 to 11 o'clock position[4].

The aircraft was manoeuvred for an emergency landing and a MAYDAY[5] declared to ATC. The instructor reported that there was insufficient time to conduct troubleshooting or to place the flaps in the down position as he was focussed on conducting the forced landing.

Emergency landing

Shortly after the main wheels contacted the ground, the engine power increased significantly. The instructor immediately pulled the throttle to idle, having assessed that landing was the safest option.

As the engine power reduced to idle, the nose wheel contacted the ground and detached. The aircraft nosed-over and slid a short distance before coming to rest inverted. After assessing that the student was uninjured, the instructor asked the student to immediately vacate the aircraft before exiting the aircraft himself.

Pilot Information

Flight instructor

The instructor held a Grade 2 (aeroplane) flight instructor licence with night VFR endorsement with a total of 2,400 flying hours. He commenced flight training in 2007 and had been employed as an instructor by the same training school since 2008.

Student pilot

The student commenced instruction 16 days prior to the accident flight and had a total of 9.2 hours.

4 The clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face.

5 Mayday is an internationally recognised radio call for urgent assistance.

Aircraft information

HCE was a tricycle, fixed gear, utility aeroplane manufactured in the United States in 1979. At the time of the accident the aircraft had a total time in service of 16,604 hours.

HCE had been fuelled to full capacity on the afternoon of Friday, 23 September 2011. The aircraft was operated for a 1.1 hour circuit flight the following morning, then parked in the open until the accident flight on Monday, 26 September 2011.

Fuel system

The aircraft fuel system consisted of two standard fuel tanks (one in each wing), a fuel shutoff valve, fuel strainer, manual primer and carburettor. The system had three fuel drain locations – two wing tank sump drains and a fuel strainer drain.

Meteorological information

The Bureau of Meteorology (BoM) released a METAR[6] at 0700 on the morning of the accident indicating that 27.8 mm of rain was recorded at Bankstown Airport in the previous 24 hours from 0900, Sunday, 25 September 2011. Additional data from the BoM indicated that while the aircraft was parked at Bankstown Airport a total of 43.4 mm of rain was recorded.

Post-accident

The Australian Transport Safety Bureau (ATSB) was advised that HCE landed on firm ground in long grass. About 15 m from the touchdown point there was a 300 mm high mound of dirt (invisible in the long grass) which the nose wheel struck causing it to collapse.

Post-accident fuel sample

While the aircraft was still inverted, a sample of the fuel from the main fuel filter was drawn through the primer line pickup. The fluid in that sample was identified as water with no fuel evident.

6 Meteorological Terminal Aviation Weather Report.

A fuel sample could not be obtained from the carburettor due to damage sustained in the accident.

When the aircraft was righted, further fuel samples were drawn from both wing tanks. The left tank indicated clear fuel with the right tank showing significant water present in that fuel sample.

Both fuel tank filler caps and receptacles were inspected. The left wing filler cap appeared to seal correctly. The right filler cap and seal showed signs of wear, but was still considered to be in a serviceable condition.

The right fuel tank receptacle lip showed signs of significant water contact in the form of surface rust (Figure 1). The receptacle was also found to be distorted, with the forward lip appearing to have been pushed down along its inner edge.

Figure 1: Right fuel cap receptacle

Photograph courtesy of the insurer

ATSB COMMENT

Water contamination was identified in the post-accident fuel samples taken from the fuel filter and the right fuel tank.

Surface rust on the right tank fuel cap receptacle indicated that water had most likely entered the system through that point during the heavy rainfall that occurred the previous days while the aircraft was parked in the open.

The water contamination in the fuel was not identified during the pre-flight fuel drain check that was conducted by the instructor and witnessed by the student[7].

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 advised the ATSB that they were taking the following safety actions:

- Immediately following the incident, the operator inspected their fleet with one additional aircraft identified as having water present in the fuel system.
- Information evenings with students to discuss recent fuel contamination issues that resulted in partial or full loss of power were conducted.
- Compulsory instructor training on the incident as well as specific training on the Cessna type fuel system was conducted.
- Emergency checklists were reviewed in particular the way emergency checks were instructed and assessed, looking specifically at the use of memory item checks at low altitudes.

SAFETY MESSAGE

Reported engine water contamination events

A review of ATSB accident and incident data between 1998 and 2011, involving water contamination in single engine Cessna aircraft highlighted 18 events.

- C150/152 - 8 events

[7] Water contamination in fuel is identified through draining a sample of fuel from each fuel drain location; a visual check is then conducted. Water contamination in fuel can take the form of a pea, blob or ball bearing shaped translucent mass in the bottom of the sample, or if water is suspended in the fuel, the sample may have a cloudy or hazy appearance.

- C172/C182 4 events
- C206/C210 6 events

Given the volume of single-engine aircraft operations in Australia, 18 reported water contamination events is relatively low, but this accident is a prompt that such events can potentially have catastrophic outcomes.

Operators and pilots are reminded that following periods of heavy rain, or aircraft down time, extra vigilance is required during pre-flight checks to ensure that any fuel carried or sourced is free of water contamination.

This accident also highlights that effective management of engine power loss after takeoff in single engine aircraft requires positive action and the maintenance of aircraft control. See the ATSB publication, '*Managing partial power loss after takeoff in single engine aircraft*', for additional information.

www.atsb.gov.au/media/3436908/ar2010055.pdf

FAA Special Airworthiness Information Bulletin

While researching Australian and international fuel contamination events, the operator's safety committee identified a FAA Special Airworthiness Information Bulletin on water contamination in the fuel tank systems on Cessna single engine aircraft.

The bulletin outlines the hazards associated with water contamination on Cessna model 150, 170, and 172 series aircraft. The bulletin provides valuable information to all operators on water contamination identification and prevention.

http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/(LookupSAIBs)/CE-10-40R1?OpenDocument

AO-2011-119: VH-CIX and VH-KHG, Aircraft proximity event

Date and time:	27 September 2011, 1645 EST	
Location:	Mangalore Airport, Victoria	
Occurrence category:	Serious incident	
Occurrence type:	Airprox	
Aircraft registration:	VH-CIX and VH-KHG	
Aircraft manufacturer and model:	VH-CIX: Piper PA-28-151 VH-KHG: Piper PA-44-180	
Type of operation:	VH-CIX: Flying training VH-KHG: Flying training	
Persons on board:	VH-CIX: Crew – 2 VH-KHG: Crew – 2	Passengers – Nil Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 27 September 2011, a flight instructor and student pilot of a Piper Aircraft Corporation PA-28-151 (Warrior) aircraft, registered VH-CIX (CIX), departed Mangalore Airport, Victoria on a pre-general flying progress test (GFPT)[1] check flight, under the visual flight rules (VFR).

After having completed aerial work in the local training area, the instructor and student returned CIX to the airport to conduct circuits on runway 05. The instructor was aware of two other aircraft operating in the circuit at the time and two aircraft conducting practice instrument approaches to the Mangalore runway 23 very high frequency (VHF) omnidirectional radio range (VOR)[2], including a Piper Aircraft Corporation PA-44-180 (Seminole) aircraft, registered VH-KHG (KHG).

A flight instructor and student pilot[3] of KHG, operating under the instrument flight rules (IFR), were conducting a practice instrument approach to the Mangalore VOR.

When inbound at about 3 NM from the VOR, the practice instrument approach was discontinued. The aircraft was descended to the circuit height of 1,500 ft above mean sea level (AMSL) and joined on downwind for a slightly tighter than normal circuit for runway 05.

At about 1645 Eastern Standard Time[4], the student of CIX conducted a stop-and-go[5] on runway 05 and climbed to 1,500 ft AMSL on upwind. After passing the runway end, the student and instructor scanned the area for other traffic and the aircraft was turned onto crosswind.

Instructor of VH-CIX recollection of events

When the turn was completed, the instructor of CIX observed KHG on downwind, about 30 to 45 m to the right and at the same height (Figure 1). The

[1] During a GFPT, the pilot will demonstrated to an approved testing officer that they can competently manage the aircraft in all basic phases of flight.

[2] 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.

[3] A third student pilot was also onboard the aircraft at the time as a passenger.

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

[5] The aircraft is brought to a complete stop on the runway after landing, before taking off again.

instructor did not expect to see an aircraft at that position, on a tighter than normal downwind leg.

The instructor immediately assumed control of the aircraft, reducing the engine power to idle and descending about 200 ft. Immediately after descending and while still on crosswind, the instructor in CIX reported making a broadcast on the Mangalore common traffic advisory frequency (CTAF)[6] to KHG asking if they had CIX sighted, however no response was received.

The instructor then turned CIX onto downwind in front of KHG. Shortly after, the instructor of CIX reported hearing a broadcast from KHG indicating that they were on downwind behind CIX.

The instructor of CIX reported hearing a number of broadcasts from KHG prior to the incident, including outbound and inbound calls to the VOR and, about five minutes prior to the incident, having commenced the holding pattern for the runway 23 VOR approach. The instructor was not aware that KHG was in the circuit until sighted on crosswind.

Instructor of VH-KHG recollection of events

While conducting the VOR approach, the student of KHG broadcast outbound and inbound calls on the Mangalore CTAF. The instructor also reported hearing a broadcast from CIX indicating that they were turning final for runway 05. The instructor of KHG reported that his student had made a “joining downwind” broadcast for runway 05 on the Mangalore CTAF when they were at the standard crosswind to downwind turning point. At that time, they did not observe any conflicting traffic.

Soon after, the instructor sighted CIX below and off to his left, flying straight and level and established on a slightly earlier than normal crosswind leg. CIX then passed in front of KHG, about 100 to 200 ft below and 100 m in front. CIX turned onto downwind as KHG passed abeam the upwind threshold for runway 05. The instructor had expected CIX to turn onto downwind behind his aircraft, but slowed KHG and manoeuvred the aircraft behind CIX onto downwind. KHG reported responding to a query from CIX that he did have CIX in sight. The instructor of KHG believed that call had been made when CIX was on downwind.

[6] Transmissions broadcast on the Mangalore CTAF were not recorded.

ATSB Comment

The pilots in command of the two aircraft involved in the incident had differing recollections of the sequence of events. Some aspects of their statements could not be reconciled.

As CIX was below and flying straight and level on crosswind when first sighted by the instructor of KHG, it is likely that KHG did not sight CIX until after the airprox[7] had occurred and CIX had descended.

The instructors of both CIX and KHG reported that the position of the other aircraft was not as expected; this factor may account for why they were not initially sighted when visual traffic scans were conducted.

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

CIX and KHG were both operated by the same operator. As a result of this serious incident, the operator conducted an internal investigation into the incident and advised the ATSB that they had introduced a procedure whereby, when the wind conditions favoured a take-off towards the north or north-east, aircraft joining the circuit from a practice instrument approach were to descend to an overfly height of 2,000 ft AMSL and join the circuit from the non-active side of the circuit.

SAFETY MESSAGE

Whenever operating in a non-standard manner (e.g. turning crosswind over the upwind threshold or tracking for a closer than normal downwind), pilots should broadcast their position and intent. This is especially the case when operating in an environment where other pilots are conditioned to

[7] An occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists, or may exist, in airspace where separation is a pilot responsibility.

your 'ordinary' behaviour (e.g. both aircraft are from the same company and are operating at their home airport).

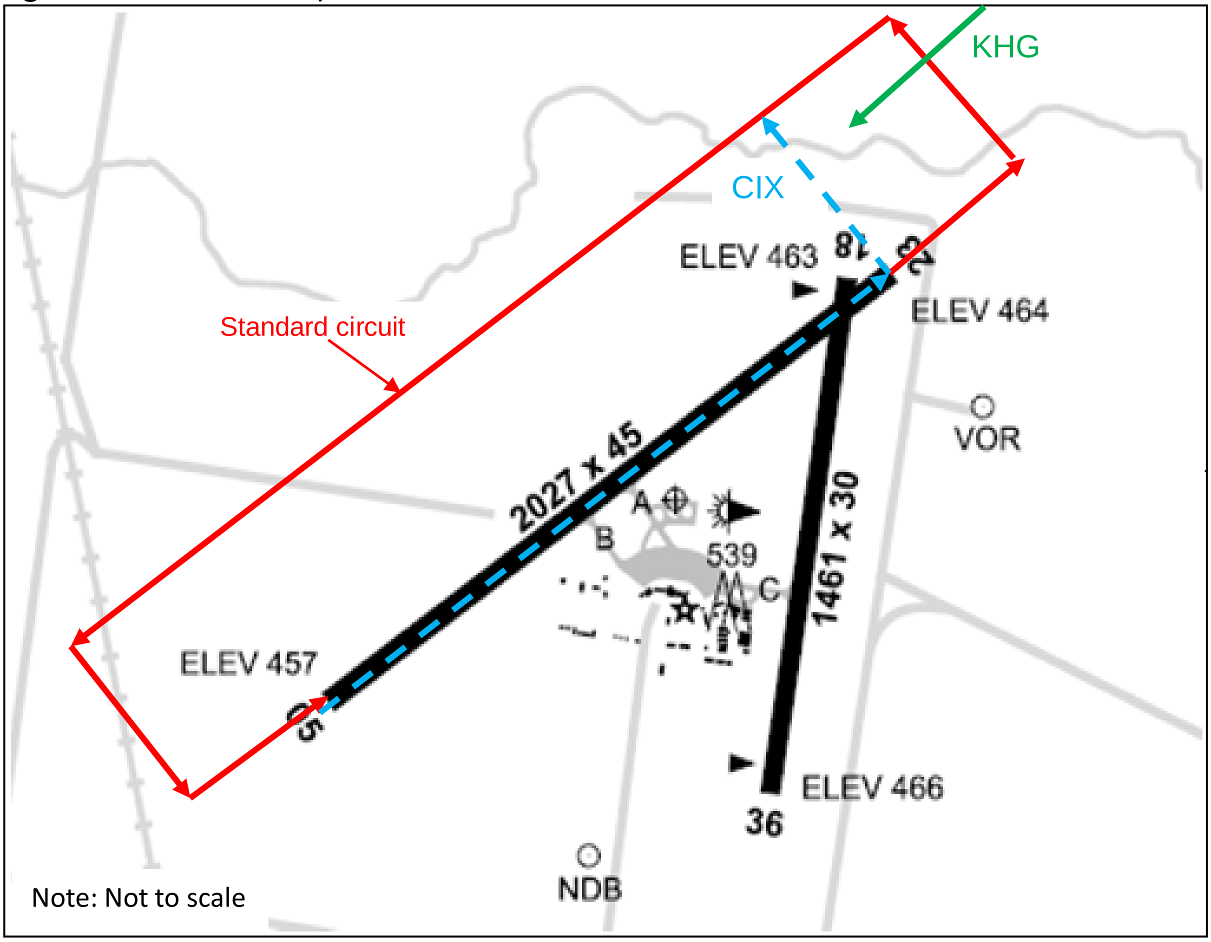
The ATSB research report: *A pilot's guide to staying safe in the vicinity of non-towered aerodromes,* identified that, between 2003 and 2008, there were 61 conflicts involving aircraft operating in the circuit at non-towered aerodromes. The report stated:

> Broadcasting on, and monitoring, the CTAF effectively helps to reduce the risk of a mid-air collision or reduced separation incidents by supporting pilots' visual lookout for traffic and situation awareness, and assisting them to mutually separate their aircraft. Pilots are expected to make a series of standard broadcasts regarding their position and intentions, including immediately before joining the circuit.

The following publications provide further information on alerted see-and-avoid and operations at non-towered aerodromes:

- Staying clear of other aircraft in uncontrolled airspace www.atsb.gov.au/publications/2011/staying-clear-of-other-aircraft-in-uncontrolled-airspace.aspx
- A pilot's guide to staying safe in the vicinity of non-towered aerodromes www.atsb.gov.au/media/2097901/ar2008044(1).pdf
- Operations at non-towered aerodromes www.casa.gov.au/wcmswr/_assets/main/pilots/download/nta_booklet.pdf
- Civil Aviation Advisory Publication (CAAP) 166-1(0): Operations in the vicinity of non-towered (non-controlled) aerodromes www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/166-1.pdf
- CAAP 166-2(0): Pilots' responsibility for collision avoidance in the vicinity of non-towered (non-controlled) aerodromes using 'see-and-avoid' www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/166-2.pdf
- Collision avoidance strategies and tactics www.aopa.org/asf/publications/sa15.pdf

Figure 1: Estimated aircraft positions in relation to a standard circuit



AO-2011-120: VH-MST and VH-UZL, Aircraft proximity event

Date and time:	25 September 2011, 1400 EST	
Location:	West of Toowoomba, Queensland	
Occurrence category:	Incident	
Occurrence type:	Airprox	
Aircraft registration:	VH-MST and VH-ULZ	
Aircraft manufacturer and model:	VH-MST: Cessna Aircraft Company C-182P VH-ULZ: Schempp-Hirth Ventus-2c	
Type of operation:	VH-MST: Private VH-ULZ: Gliding Competition	
Persons on board:	VH-MST: Crew – 1 VH-ULZ: Crew - 1	Passengers - 3 Passengers - Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 25 September 2011, a Cessna Aircraft Company 182P, registered VH-MST (MST), departed Roma airport, Queensland (Qld), on a private flight. On board the aircraft were the pilot and three passengers. The pilot planned a direct track from Roma to Toowoomba at 9,500 ft above mean sea level (AMSL).

On the same day, a Schempp-Hirth Ventus 2c glider, registered VH-ULZ (ULZ), departed Warwick aerodrome, competing in the Queensland State Soaring Championships. The course for that day's race took in the turning points of Warwick, Maryvale, Jimbour and Cecil Planes before returning to Warwick. At the time of the incident, the pilot of ULZ was on the Maryvale to Jimbour leg of the course. The pilot stated that tracking via thermals on the day took ULZ "very close to Toowoomba."

At approximately 1400 Eastern Standard Time[1] (EST), at a position 5NM west of Toowoomba and a height of 4,000 ft above mean sea level (AMSL), the pilot of MST noticed glider ULZ, between 300 m and 500 m directly in front of MST at the same level and heading towards MST. The pilot of MST commenced an evasive descending turn to the left to avoid ULZ.

It was estimated the distance between the two aircraft came close to 100 m horizontally at the same level.

Pilot of VH-MST recollection of events

The pilot stated that he obtained the NOTAMs[2] for the area earlier that day and noted that:

- the Oakey airspace was deactivated,
- a NOTAM was current for the area for a gliding event involving up to 40 gliders between Warwick/Kingaroy/Roma and Goondiwindi from surface to 10,000 ft.

The pilot of MST stated that, due to the gliding event, he made an additional 30 mile call inbound to Toowoomba on descent through 8,500 ft on the Oakey/Toowoomba[3] CTAF

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

[2] A Notice To Airmen distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

[3] Toowoomba is a certified aerodrome: The CTAF(R) designation was abolished from 3 June 2010, when radio carriage and use became mandatory at all registered, certified, military, and other specified non-towered aerodromes.

frequency. The pilot of MST recalled receiving a reply from:

- The pilot of a glider, registered VH-GAW (GAW), overhead Oakey tracking north-west for Jimbour and,
- The pilot of a Robinson R22 helicopter, registered VH-YZO (YZO), conducting circuits at Oakey.

The pilot of MST did not recall hearing a call from ULZ and was unaware of ULZ's position until the incident.

The pilot of MST stated that, following the incident, he attempted to make radio contact with the pilot of ULZ on the CTAF frequency and had no response.

Pilot of VH-ULZ recollection of events

At about 5 NM west of Toowoomba, ULZ was thermalling[4] around 3,000 ft above ground level (AGL). The pilot noticed an aircraft about 2 NM above and ahead of ULZ on track for Toowoomba. The pilot stated that the two aircraft were approaching head on. However he did not think that there was any potential for a conflict.

The pilot of ULZ stated that he did not broadcast on the CTAF and did not recall hearing MST make an inbound call to Toowoomba. However, the pilot did recall hearing GAW broadcasting on the CTAF at the time. The pilot stated that it was common practice to switch between monitoring the CTAF frequency and the gliders 'gaggle' frequency[5]. The pilot stated it was possible that he was on the 'gaggle' frequency when MST broadcast his inbound call.

Pilot radio communications

The Australian Transport Safety Bureau (ATSB) examined recordings of the transmissions broadcast on the joint Oakey / Toowoomba CTAF at the time. That examination revealed that the pilot of MST broadcast an inbound call on the Toowoomba CTAF, 20 NM to the south-west of Oakey on decent through 8,700 ft.

The pilot of MST made a further broadcast 10 NM south-west of Oakey passing through 6,600 ft inbound for Toowoomba, where glider GAW, replied that he was overhead Oakey at 3,600 ft.

MST made a broadcast directed to YZO, 3 NM south of Oakey stating they were tracking direct to Toowoomba passing through 5,700 ft. The pilot of MST made a further broadcast directed to 'Toowoomba traffic' 8 NM west of Toowoomba on descent through 4,100 ft.

The next broadcast from MST was to 'the glider to the south west of Toowoomba' (ULZ). There was no response.

Figure 1: Gliding Competition Task Area

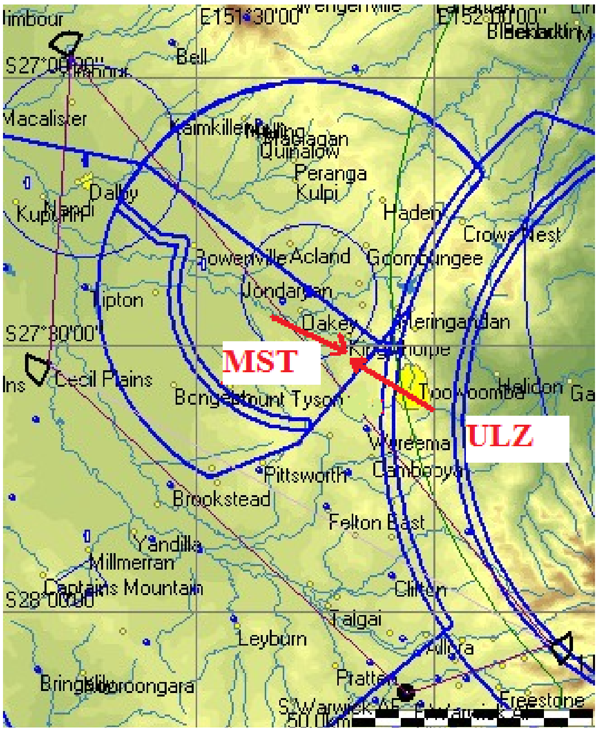


Image courtesy Gliding QLD

CTAF PROCEDURES

CAR 166C requires pilots to make a broadcast whenever it is necessary to do so to avoid a collision, or the risk of a collision with another aircraft.

The Aeronautical Information Publication (AIP) Enroute (ENR) section details various recommendations relating to operations outside controlled airspace (G airspace), including CTAF

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4 To use a local column of rising air in the atmosphere as energy input for soaring flight.

5 Discrete frequency for glider to glider communication.

procedures and communication for both powered and unpowered aircraft.

With reference to communication for gliders, ENR 5.5-1 includes:

- Except for operations in controlled airspace gliding operations may be conducted no-radio, or may be on a discrete frequency allocated for use by gliders.
- Radio equipped gliders at non-towered aerodromes will use the CTAF.
- Except when operationally required to maintain communications on a discrete frequency, glider pilots are expected to listen out on the area VHF and announce if in potential conflict.

AIP ENR 1.1 details various recommendations for operations in the vicinity of a non-towered aerodrome where the carriage of radio is mandatory, including:

- In the vicinity of a non-towered aerodrome where the carriage of a radio is mandatory pilots should always monitor the CTAF and broadcast their intentions at least in accordance with the minimum calls outlined in table, Summary of Broadcasts – All aircraft at Non-Towered aerodromes.
- If a pilot intends to fly through the vicinity of, but not land at, a non-towered aerodrome – broadcast when the aircraft enters the vicinity[6] of the aerodrome.

Gliding Competition Rules

The Queensland State Gliding Championships Local Rules required all aircraft competing in the competition to be equipped with a serviceable VHF radio. Specifically the local rules stated;

- En route all pilots should monitor 122.9 (glider gaggle frequency). "Use of this frequency is mandatory when entering or near gaggles or flying with or near other gliders."
- Competitors must take particular note of the airspace requirements applicable to the task area. Penalties applied for flights infringing controlled airspace and were prescribed in the National Rules.

The Gliding Championship Local Rules must be read in conjunction with The Gliding Federation of Australia Airways and Radio Procedures for Glider Pilots, which stated;

- All pilots must monitor and communicate on the CTAF frequency whenever they are operating at or in the vicinity of a non-towered aerodrome.
- The height may vary considerably in consideration of local traffic however all aircraft are expected to operate on the CTAF frequency whenever at or below 3000 ft AGL and higher where appropriate.

    Further the Gliding Federation of Australia Manual of Standard procedures provides at 25.1.3;

- Radio equipped gliders are not permitted to use one of the gliding frequencies in a CTAF area (unless the designated CTAF frequency is a gliding frequency.)

ATSB COMMENT

It is likely that had the pilot of ULZ been constantly monitoring the CTAF, he would not have missed the position reports made by MST. Conversely, had the pilot of ULZ transmitted his position and intentions on the CTAF, MST would have been alerted to the presence of ULZ as he was alerted to the presence of GAW.

While the inclusion of the glider 'gaggle' frequency, in future NOTAMs regarding intensive glider activity, would provide other airspace uses with access to those broadcasts. It was considered that such action may result in greater confusion over which frequency to monitor and lead to more opportunities for calls to be missed. Further the Gliding Federation of Australia standard procedures unequivocally require glider pilots to use the designated CTAF frequency in the vicinity of a CTAF and not a discrete gliding frequency.

[6] Vicinity of the aerodrome is defined as in airspace other than controlled airspace, within 10nm of the aerodrome and at a height above the aerodrome that could result in conflict with operations at the aerodrome.

SAFETY MESSAGE

By itself, the concept of 'see-and-avoid' is far from reliable. It is important that pilots apply the principles of 'see-and-avoid' in conjunction with an active listening watch. Research has shown the effectiveness of a search for other traffic is eight times greater under alerted circumstances than when un-alerted[7].

Pilots should be mindful that transmission of information by radio does not guarantee receipt and complete understanding of the information. Without understanding and confirmation of the transmitted information, the potential for alerted see-and-avoid is reduced to the less safe situation of un-alerted see-and-avoid.

A 2004 ATSB review of all 37 mid-air collisions in Australia between 1961 and 2003 (ATSB, 2004) identified that radio problems, use of the wrong frequency, or failure to make the standard positional broadcasts led to many of these collisions[8].

- In at least six of the aeroplane/aeroplane collisions, one or both pilots did not hear a required radio broadcast made by the other pilot.
- In three of the aeroplane/glider collisions, neither pilot was using the radio.
- In two of the aeroplane/glider collisions, one of the pilots did not make the standard positional broadcasts.
- In one of the aeroplane/glider collisions, one of the pilots used the wrong frequency to make the standard broadcasts.
- In one of the aeroplane/aeroplane collisions at a non-towered aerodrome, the pilot did not make a required broadcast due to radio frequency congestion.

It is imperative that pilots make a broadcast with position and intentions in the vicinity of a CTAF particularly when changing frequencies or if there is any doubt as to the position of other aircraft. These occurrences show clearly that simply having a radio is no guarantee of safety.

The following publications provide some useful information on the see-and-avoid principles:

- *Limitations of the see-and-avoid principle* (1991), available from the ATSB's website at www.atsb.gov.au
- *Safety in the vicinity of non-towered aerodromes* (2010) AR-2008-044(2), available from the ATSB website at www.atsb.gov.au
- *Pilots responsibility for collision avoidance in the vicinity of non-towered (non-controlled) aerodromes using the 'see-and-avoid'* (Civil Aviation Advisory Publication CAAP 166-2(0), available from the Civil Aviation website at www.casa.gov.au

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.

The Gliding Federation of Australia

The Gliding Federation of Australia (GFA) recognised that the Competition Local Rule that required all pilots to use the gliding frequency 122.9MHz "*when entering or near gaggles or flying with or near other gliders*" may have inadvertently led to confusion. While it was not the intention of the competition organisers to override the Civil Aviation Regulations, it is likely that some competing pilots may have interpreted this requirement literally.

As a result of this occurrence, the Gliding Federation of Australia has advised the ATSB that they will ensure that competition local rules reinforce the radio requirements for operating at, or in the vicinity of non-towered aerodromes and clarify when the 'gaggle' frequency is to be used.

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7 *Limitations of the see-and-avoid principle* (1991) ATSB, at paragraph 2.6.1 available from the ATSB's website at www.atsb.gov.au

8 *Safety in the vicinity of non-towered aerodromes* (2008) AR-2008-044(2), available from the ATSB's website at www.atsb.gov.au

AO-2011-121: VH-IOL / VH-YEN, Aircraft proximity event

Date and time:	26 September 2011, 1142 EST	
Location:	26 NM (49 km) SE of Scone Aerodrome, New South Wales	
Occurrence category:	Serious incident	
Occurrence type:	Airprox event	
Aircraft registration:	VH-IOL / VH-YEN	
Aircraft manufacturer and model:	Beech Aircraft Corporation Bonanza A36 / Beech Aircraft Corporation Bonanza A36	
Type of operation:	Aerial work / Private	
VH-IOL		
Persons on board:	Crew – 2	Passengers –0
Injuries:	Crew – 0	Passengers – 0
VH-YEN		
Persons on board:	Crew – 1	Passengers – 3
Injuries:	Crew – 0	Passengers – 0
Damage to aircraft:	Nil	

FACTUAL INFORMATION

At 1142 Eastern Standard Time[1] on 26 September 2011, a Beech Aircraft Corporation, A36 (Bonanza) aircraft, registered VH-YEN (YEN), was flying north at 2,700 ft from Camden, New South Wales, to Queensland. At the same time another Bonanza aircraft, registered VH-IOL (IOL) was conducting aerial survey operations above the Ravensworth coal mine, south-east of Scone, New South Wales. Both aircraft were operating under the Visual Flight Rules (VFR) in visual meteorological conditions (VMC). The aircraft were flying in class G airspace, clear of any significant aerodromes. The radio frequency for VFR operations in that area was Brisbane Centre air traffic services (ATS) on 124.8 MHz.

The pilot of IOL reported that he was concentrating on navigational guidance equipment to maintain an accurate flight path on a westerly heading when he heard a radio broadcast from ATS, stating that two aircraft were visible on radar in his vicinity, on converging trajectories. The pilot directed his vision to search for other aircraft and reported that he observed another aircraft to the front, passing from left to right on a northerly heading. The pilot turned his aircraft left and observed the other aircraft passing to his right with approximately 300 ft horizontal and 50 ft vertical separation. The pilot read the call sign VH-YEN, visible on the aircraft fuselage as they passed each other. The pilot of IOL estimated that YEN would soon fly near Scone, and a few minutes later made contact with the pilot of YEN on the Scone Common Traffic Advisory Frequency (CTAF).

The pilot of YEN reported that he had not been monitoring the Brisbane Centre radio frequency because the aircraft was at or below the minimum altitude to assure radio communication with ATS. The pilot of YEN did not see IOL and only became aware of the close proximity to IOL when they communicated by radio a few minutes later on the Scone CTAF frequency.

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

Pilot details

The pilot of IOL held a Commercial pilot licence (aeroplane), with a total aeronautical experience of 4,600 hours, and 325 hours on the Bonanza.

The pilot of YEN held a Private pilot licence (aeroplane), with a total aeronautical experience of 240 hours, and 107 hours on the Bonanza.

Communication

There was no requirement for either aircraft to be equipped with a radio when operating in G airspace in VMC below 5,000 ft.

However, the Aeronautical Information Publication (AIP) Enroute (ENR) section 1.1.44.1 stated that:

> Pilots of radio-equipped VFR aircraft must listen out on the appropriate VHF frequency and announce if in potential conflict. Pilots intercepting broadcasts from aircraft in their vicinity which are considered to be in potential conflict with their own aircraft must acknowledge by transmitting own call-sign and, as appropriate, aircraft type, position, actual level and intentions.

Both aircraft were radio-equipped. The pilot of IOL had been monitoring the relevant flight information frequency so was alerted to the presence of the other aircraft. The pilot of YEN had not been monitoring the relevant flight information frequency so could not be alerted by ATS if the aircraft was in range, nor could he have been alerted by other aircraft in the vicinity on the area frequency, even if they were operating below 5,000ft.

Collision avoidance equipment

Both aircraft were equipped with a transponder that was selected to Mode C. This equipment enabled air traffic control to be aware of the location and altitude of each aircraft.

Flight crew of aircraft equipped with a collision avoidance system are provided information about nearby traffic, based on received information from transponder-equipped aircraft operating on Mode C. This system works whether the aircraft are inside or outside ground-based radar coverage.

IOL was equipped with a portable collision avoidance system (PCAS). The pilot reported that he had switched off the PCAS when flying over Ravensworth coal mine, because the ground based transponder-equipped mining machinery provided many spurious and irrelevant signals to the PCAS.

SAFETY MESSAGE

The Brisbane Centre ATS does not by default provide a traffic information service to VFR aircraft in Class G airspace. If ATS had not provided traffic information then it is likely that neither pilot would have been aware of the other.

By itself, the concept of unalerted 'see-and-avoid' is far from reliable. It is important that pilots apply the principles of 'see-and-avoid' in conjunction with an active listening watch. Research has shown the effectiveness of a search for other traffic is eight times greater under alerted circumstances than when un-alerted.

Although the aircraft came into close proximity in airspace where separation is based on visual separation, the probability of a mid-air collision was significantly reduced by the alerting broadcast from ATS that alerted one pilot shortly before the closest point of approach.

The risk would have been further reduced if both pilots had been monitoring the correct en-route frequency, which would have enabled them to be alerted by regular broadcasts from both ATS if it was in radio range, as well as from the other aircraft in the area.

The benefits of alerted see-and-avoid are described in the ATSB research reports:

- Limitations of the See-and-Avoid Principle (1991) www.atsb.gov.au/media/32918/limit_see_avoid.pdf and
- AR-2008-044(1) A pilot's guide to staying safe in the vicinity of non-towered aerodromes www.atsb.gov.au/media/2097901/ar2008044(1).pdf

AO-2011-123: VH-TXD, Violation of controlled airspace

Date and time:	26 September 2011, 1152 EST	
Location:	near Altona, Victoria	
Occurrence category:	Incident	
Occurrence type:	Violation of controlled airspace	
Aircraft registration:	VH-TXD	
Aircraft manufacturer and model:	Piper PA-28-181	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew –Nil	Passengers –Nil
Damage to aircraft:	Nil	

FACTUAL INFORMATION

On 26 September 2011 at 1151 Eastern Standard Time[1], the flight crew of an Airbus Industrie A321 (Airbus) aircraft, registered VH-VWW, received a traffic alert and collision avoidance system (TCAS) traffic advisory (TA) alert for an aircraft that was approaching from their front-right position at 2 NM (3.7 km) at an altitude of 2,700 ft. The Airbus was maintaining 3,000 ft on an ARBEY standard terminal arrival route to runway 34 Left at Melbourne Airport, Victoria and was operating in Class C controlled airspace.[2] The upper limit of Class G airspace[3] for the area was 2,500 ft.

The crew of the Airbus notified Melbourne air traffic control (ATC) of the TCAS TA alert. The departures controller advised the crew that the other aircraft appeared to be a Visual Flight Rules[4] flight, 1 NM to the east and at an unverified altitude of 2,800 ft.

The controller, managing the Melbourne radar service in Class G airspace, called the pilot of the other aircraft and requested confirmation of the aircraft's current altitude. The pilot reported that the aircraft, a Piper PA-28-181 (Archer), registered VH-TXD, was maintaining 2,500 ft. The ATC radar display showed the aircraft's Mode C[5] as an unverified 2,800 ft. At that altitude, the aircraft was inside Class C airspace. As the pilot had not been issued with a clearance to enter the Class C airspace, a violation of controlled airspace occurred.

The radar service controller notified the pilot of the Archer that Melbourne Airport's QNH[6] was 1021 hectopascals to enable the pilot to check the aircraft's altimeter setting.

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

2 Controlled airspace is a generic term which, In Australia, covers ATS airspace classes A, C, D and E.

3 Non-controlled airspace in Australia is classified as Class G airspace.

4 Visual flight rules (VFR) are a set of regulations which allow a pilot to only operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

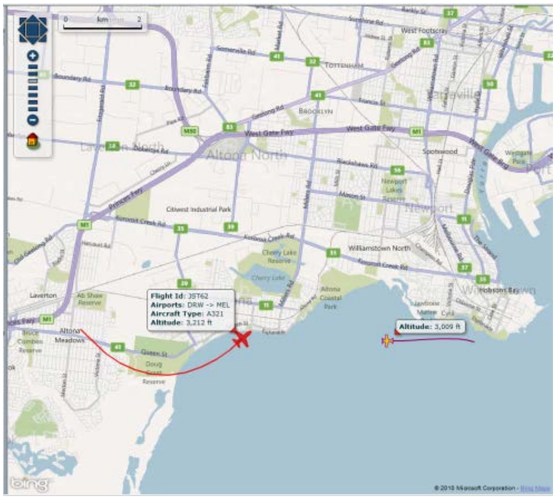
5 An aircraft transponder signal with barometric information from an encoding altimeter, encrypted so that it enables altitude presentation on air traffic control radar screens.

6 Altimeter barometric pressure subscale setting to provide altimeter indication of height above mean seal level in that area.

A later check of Airservices Australia noise monitoring Webtrak system showed that the aircraft was in Class C airspace at the time at an indicated altitude of 3,009 ft[7] (Figure 1). Webtrak is available at:

www.airservicesaustralia.com/aircraftnoise/webtrak

Figure 1: Webtrak depiction of aircraft tracks



The weather at the time was CAVOK.[8]

The pilot of the Archer later reported that he misheard the QNH from the Moorabbin Airport automatic terminal information service and used an incorrect value to set the aircraft's altimeter. He could not understand why he did not detect the error during his cross-check of the altimeter readout against the airport elevation. Moorabbin Airport elevation is 50 ft above mean sea level.

There were no reported aircraft maintenance issues that may have contributed to the incorrect setting of the altimeter.

Pilot experience

The pilot of the Archer had about 170 hours total flying experience and was familiar with operations in the Moorabbin/Melbourne area.

SAFETY MESSAGE

The incident was resolved due to the traffic alert from the Airbus A321 aircraft's TCAS and the subsequent response from the flight crew.

This incident acts as a reminder to pilots of the importance to cross-check cockpit settings before flight. Pilots are also reminded that the Civil Aviation Safety Authority (CASA) provides Visual Pilot Guides (VPGs), covering capital city areas, on its website to assist pilots on VFR flights to plan and conduct flights.

A VPG for Melbourne is available at: www.casa.gov.au/wcmswr/_assets/main/pilots/download/melbourne.pdf

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7 Webtrak displayed altitude is not corrected for QNH.

8 Ceiling and visibility OK, meaning that visibility, cloud and present weather better than prescribed conditions. For an aerodrome weather report, those conditions are visibility 10 km or more, no significant cloud below 5,000 ft or cumulonimbus cloud and no other significant weather within 9 km of the aerodrome.

AO-2011-133: VH-TIS, Birdstrike

Date and time:	15 October 2011, 1800 EST	
Location:	Ayr, Queensland	
Occurrence category:	Accident	
Occurrence type:	Birdstrike	
Aircraft registration:	VH-TIS	
Aircraft manufacturer and model:	Cessna Aircraft Company 182P	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 5
Injuries:	Crew – 1 (minor)	Passengers – 5 (minor)
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 15 October 2011 at about 1800 Eastern Standard Time[1], a Cessna Aircraft Company 182P, registered VH-TIS (TIS), departed Ayr, Queensland on a private flight within the local area. On board were the pilot and five passengers.

Shortly after commencing descent from 1,000 ft into Ayr Aircraft Landing Area (ALA), the pilot noticed a bird to the left of the aircraft, followed almost immediately by an impact with the windscreen. The bird penetrated the windscreen, causing it to shatter.

The pilot reported feeling an impact on his face, followed by a strong wind and loud noise through the cockpit. He attempted to determine the engine performance and aircraft controllability. The pilot selected full power and experimented with different attitudes to establish where the greatest airspeed could be maintained. The maximum performance the pilot was able to obtain was a slow descent at 60 kts in a nose-high attitude. The pilot recalled that in that attitude TIS displayed signs of pre-stall buffeting[2].

As the pilot was unable to maintain altitude, on approaching 200 ft above ground level (AGL), the pilot decided to conduct a forced landing. He decided not to lower the flaps during the approach as he was concerned about a deterioration of the aircraft's handling characteristics if he changed configuration.

Due to the nose-high attitude, the pilot could not see towards the front of the aircraft, however he observed a cane field to the left and selected this as a suitable landing area.

About 15 seconds prior to landing in the cane field, the pilot briefed the passengers to move as far forward as possible to lessen the deceleration force on landing. The passengers were wearing parachutes as part of a training exercise and were restrained by a single-point restraint attached through the webbing in the parachute.

The pilot felt that the aircraft was approaching the pre-stall buffet as he came into land. He recalled that the rudder controls felt "mushy" and the control column was almost at full backstick.

The pilot flew through the cane rather than trying to land on the ground in order to reduce the deceleration forces. TIS came to a stop and the pilot and passengers were able to exit the aircraft through the jump door and the windscreen. The pilot and passengers sustained minor injuries.

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

2 Aerodynamic buffet induced by turbulence over wing and or control surfaces or fixed tail giving warning of an imminent stall.

The bird remains suggested it may have been a Magpie Goose (Figure 1).

Figure 1: Magpie Goose

Image courtesy of Wikipedia

Bird activity

The pilot did not observe any bird activity in the area prior to departure or during the flight. The pilot reported that birds are seldom seen at the airport, however other airport users had seen birds near the airport recently.

The airport operator reported that birds are occasionally seen at the airport, however there had been no reported problems with wildlife. There was no requirement for an aerodrome bird hazard management plan at Ayr ALA as it was not a certified aerodrome under Part 139 of the Australian Civil Aviation Safety Regulations.

Pilot Experience

The pilot had about 220 hours total flying experience, 180 hours on the 182 and 13,000 skydiving jumps. He reported that for the past 14 months he had operated TIS weekly while conducting sky-diving operations.

The pilot commented that the practice forced landing exercises conducted during his private pilot licence training played a vital role in the safe outcome of this event. He also noted that his instructor had advised him that cane fields could be potentially suitable forced landing field and he used this knowledge to determine a suitable landing area.

The pilot also recalled that he had taken an active interest in aircraft accidents and this helped him in considering different strategies during the event. The pilot had seen an aircraft accident investigation documentary which had shown a damaged aircraft lose control after lowering of the flaps and he was mindful of that possibility during the approach.

SAFETY MESSAGE

Following the birdstrike, the pilot focused on maintaining control of the aircraft. The decision to make a controlled landing into a cane field resulted in a safe outcome for all on-board.

While it is difficult to prevent birdstrikes, a number of proactive measures can be taken by both pilots and airport operators to reduce the risk. These include not flying at times of known high activity (usually dusk), looking for bird activity in the vicinity of the airport prior to departure and actively reducing bird attractants (water and food sources) from the airport surroundings.

The Flight Safety Foundation (FSF) issued a report titled 'Bird strike mitigation beyond the airport'. The report stated:

> While general aviation airplanes typically do not have the same engine ingestion concerns as transport category jets, their overall design and certification make them much less able to resist damage from bird strikes. Mid-size to large birds can penetrate the windshields and can cause pilot incapacitation or disorientation, resulting in loss of control. The drag caused by the loss of the windshield has also resulted in accidents because enough thrust is not always available to overcome the huge drag increase.

Although it is not always practical, the report suggested the following technique for manoeuvring clear of birds:

> If birds are encountered en route, on climb or descent, the flight crew should pull up – consistent with good piloting technique – to pass over the birds.... Birds may turn or dive as avoidance manoeuvres, but they rarely climb. So pulling up is the best and fastest avoidance manoeuvre.

The complete FSF report can be found at the following link:

www.flightsafety.org/asw/aug10/asw_aug10_p44-47.pdf

AO-2011-156: VH-PEE, Runway excursion

Date and time:	5 December 2011, 1030 EDT
Location:	26 km south-east of Gunnedah Aerodrome, New South Wales
Occurrence category:	Accident
Occurrence type:	Runway excursion
Aircraft registration:	VH-PEE
Aircraft manufacturer and model:	Taylorcraft BC12-D
Type of operation:	Private

Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – Nil	Passengers –Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 5 December 2011, at about 1030 Eastern Daylight-saving Time[1], a Taylorcraft BC12-D aircraft, registered VH-PEE (PEE), was engaged in taxi trials as part of a pre-flight inspection for a flight scheduled later that day. The pilot who was the sole occupant reported that, while using a grass runway, 26 km south-east of Gunnedah Aerodrome, NSW, the aircraft was struck by a very strong wind gust or willy-willy[2] and on attempting to correct its course with engine power and right rudder, the aircraft veered off of the runway.

The pilot was unable to regain control of the aircraft which subsequently struck a fence about 600 m down the runway on the left side of the runway and flipped over, coming to rest inverted. There were no injuries sustained, however, the aircraft incurred damage to the propeller, one wing strut and the wing surfaces (Figure 1).

Figure 1: Wreckage close-up

Photo courtesy of the pilot

Aircraft information

The aircraft, a BC12-D, serial number 8256, was a light, two-place, single-engine, high-wing, tail-wheel general aviation aircraft that was built by the Taylorcraft Aviation Corporation, US in 1946 and was first registered in Australia on 31 August 1994 in the Private category (Figure 2). It was

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

[2] Miniature whirlwind with the potential to be of considerable intensity, and to pick up dust and perhaps other items and carry them some distance in the air. Willy-willies can cause localised intense turbulence.

fitted with a Continental model C-85 four-cylinder horizontally opposed air-cooled 85 hp engine.

Figure 2: VH-PEE

Photo courtesy of Ian McDonell

Pilot information

The pilot held a private pilot licence with about 12,000 hours experience on tail-wheel type aircraft, and about 500 hours on the BC12-D.

Pilot comment

During his report on the incident, the pilot expressed concerns about the suitability and effectiveness of the aircraft braking system and available engine power in correcting a violent weather event such as experienced and believed these were insufficient to maintain directional control of the aircraft.

Metrological information

Weather observations by the pilot at the time was 10 kts wind from the north-north-east.

Willy-willies (Dust devils)

The Bureau of Meteorology Research Centre, *Research Report No. 20, A Survey Of Australian Dust Devils, dated June 1990*[3] assessed the implications of dust devils for aviation. The salient points of that report identified that:

- the major hazard to light aircraft and helicopters is during landing or takeoff or when operating close to the ground
- dust devil gust strengths during the study were observed up to 39 kts
- not all dust devils are visible especially over runways
- the heights of the vortex may extend beyond the height of the dust and may reach typically 2-3 km
- the study showed dust devils mainly occur between 1000 and 1500 local time
- there was a tendency for dust devils to form near the edge or over runways.

ATSB COMMENT

The formation of the willy-willy that the pilot reportedly encountered was consistent with research into the phenomena, and most likely would not have been seen. The pilot believed his ability to control the aircraft was restricted by the limitations of the brake design and power capabilities of the engine.

SAFETY MESSAGE

Studies have shown that willy-willies can be unseen, unpredictable and adversely affect light aircraft and helicopters when they are operating on the ground or close to the ground.

This accident reinforces the need for pilots to be vigilant when operating in areas prone to the formation of willy-willies and be prepared to react quickly to mitigate their effects on the controllability of the aircraft.

The following provides useful information on willy-willies:

- ATSB aviation report 200605133, Loss of Control, Mt Vernon Station, WA, 1 September 2006, VH-RIL, Cessna 172L: www.atsb.gov.au/publications/investigation_reports/2006/AAIR/aair200605133.aspx
- Recreational Aviation Australia Flysafe tutorial 9.3 Convection currents; http://flysafe.raa.asn.au/groundschool/umodule21.html
- Spillane, K.T. and Hess, G.D., Fair Weather Convection and Light Aircraft, Helicopter and Glider Accidents in Journal of Aircraft Vol 25, No 1, Washington, Jan 1988, p. 55-61.

[3] BMRC Research Report No20 .

AO-2011-083: VH-LAG, Collision with obstacle

Date and time:	21 July 2011, 1634 CST
Location:	Port Keats Airport, Northern Territory
Occurrence category:	Accident
Occurrence type:	Collision with obstacle
Aircraft registration:	VH-LAG
Aircraft manufacturer and model:	Aerospatiale AS.332L1 (Super Puma)
Type of operation:	Charter – passenger
Persons on board:	Crew – 2 Passengers – 4
Injuries:	Crew – 2 Minor Passengers – 3 Minor
Damage to aircraft:	Serious

FACTUAL INFORMATION

On 21 July 2011, at about 0700 Central Standard Time[1], the crew of an Aerospatiale AS.332L1 (Super Puma), registered VH-LAG, located at Truscott, Western Australia, were tasked with transferring maintenance personnel from Port Keats, Northern Territory, to an unmanned offshore gas rig in the Joseph Bonaparte Gulf, south-west of Darwin, Northern Territory and back.

Following breakfast, flight planning and preflight of the helicopter, the crew departed Truscott at 0845 with one of the operator's aircraft engineers onboard to deal with any helicopter problems that could arise during the round trip. The sky was clear and the winds easterly for the 1 hour 40 minute positioning flight to Port Keats. This was the PIC's first flight into Port Keats Airport. The co-pilot, however, had flown there three times previously,

After boarding three maintenance personnel at Port Keats, the crew departed at 1110 for the 30 minute flight to the gas rig. The crew landed the helicopter on the rig and shut it down to await completion of the maintenance work. Rest facilities were not available, but the crew had access to shade and ample food and water during the wait.

At 1555, the crew departed for the return flight to Port Keats. The PIC, seated in the right seat, was the pilot flying for the sector, which required a shutdown at Port Keats to refuel.

On approach to land, the crew observed aircraft on the apron where they had intended to park. After landing, at about 1630, the crew noted that there were two Metroliner aircraft, parked one behind the other, on the right side of the apron. The forward aircraft appeared to be close to departure while there was ground handling activity around the other aircraft.

As the helicopter approached the parking area, there was some discussion between the pilots about how to manoeuvre the helicopter so that there would be sufficient clearance to allow the parked aircraft to depart. The PIC was not confident that there was sufficient room to taxi and park, but proceeded with the intention to taxi past the parked aircraft to the far corner of the apron and shut down in that location.

As the helicopter entered the parking area apron, the PIC was concerned about downwash from the main rotor affecting the forward aircraft. His focus was directed to maintaining adequate clearance from the aircraft wing tip on his right, while directing the copilot to ensure there was adequate clearance from a light pole to the left of the helicopter (Figures 1 and 2). The conversation between the pilots prior to the collision is reproduced below:

> 'Just check we are clear' - PIC. '
> Yes' - copilot.
> 'Sure?' - PIC;
> 'yes' - copilot.
> 'Still clear?' - PIC;
> 'yes' - copilot.

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

Figures 1, 2, 3: Accident sequence (Right wingtip of rear parked Metro appears in left of images)

Almost immediately there was a ‘tick tick’ sound then loud crunching sounds. The main rotor blades had struck the light pole (Figure 3) and started to break apart with debris flung about. The helicopter was rapidly propelled towards the light pole, toppling over onto its left side while vibrating vigorously and shedding blade debris in all directions.

Images supplied to the ATSB

The priority for the PIC was to grab the overhead engine shutdown handles. But that was too difficult until the helicopter came to rest on its side (Figures 4 and 5). The PIC was then able to pull hard on the handle, successfully shutting down both engines.

Figure 4: Helicopter wreckage

Image courtesy of NT Police.

Figure 5: View of Port Keats Airport apron from taxiway after accident (Helicopter circled)

Image courtesy of NT Police.

The light pole bent where the main rotor blades had struck it. The upper section fell onto the helicopter with electrical wiring exposed, but unpowered. The left side of the cockpit was pushed inwards from contact with the light pole. The helicopter’s tail section was also damaged.

Injuries and other damage

The PIC and copilot moved rearward through the cabin then exited upward through the side-window emergency exits, following the passengers out of the helicopter

Various minor injuries were sustained by the occupants, except for one passenger who was uninjured. The injured were treated at the local clinic before evacuation to Darwin for further assessment.

Additional injuries included: a baggage handler struck by flying debris, who sustained a broken thumb and cut to the leg; and two occupants of a parked vehicle who received small cuts from debris that broke through the windscreen.

Three other parked vehicles were also struck by debris. The rear parked Metroliner aircraft was also struck by flying debris that punctured the fuselage and distorted adjacent structure.

Pilot experience

The PIC's total flying experience was 8,200 hours, with 5,600 hours on helicopters including 4,500 hours on the Super Puma. The copilot's total flying experience was 5,300 hours on helicopters including 1,100 hours on the Super Puma.

ATSB comment

This occurrence highlights that it can be difficult to assess the clearance of main rotors from obstacles through observation from the cockpit. Following the blade tip path may not provide sufficiently accurate guidance to the actual plane of rotation of the rotor disc due to the following:

- parallax error - resulting from the observers relative angle to the tip and obstacle
- rotor tip visibility - easier to sight between the 9 and 12 o'clock positions
- sun height/angle and background terrain can prohibit accurate assessment of clearance distances.

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

Accident investigation

The helicopter operator initiated an accident investigation that produced a number of recommendations for management to consider including:

- review and establishment of a safe distance for separation from objects during taxi
- review of operations to 'remote' airfields' and conduct risk assessments
- review of policy regarding crew use of helmets during offshore operations
- inclusion of onshore location details in local route supplements
- improved emergency communication.

SAFETY MESSAGE

As this occurrence demonstrates, when a helicopter main rotor collides with an obstacle the consequences can be disastrous. To reduce collision risk, helicopter operators should consider human limitations in assessing the hazards and ensure crews are aware of the aircraft's established safe distance for separation from objects during taxi. Accurate identification and promulgation of apron hazards could also reduce the collision risk.

AO-2011-113: VH-HBA, In-flight fire

Date and time:	12 September 2011, 0815 CST
Location:	80km SSW McArthur River Mine, Northern Territory
Occurrence category:	Accident
Occurrence type:	In-flight fire
Aircraft registration:	VH-HBA
Aircraft manufacturer and model:	Robinson Helicopter Co R44 Astro
Type of operation:	Charter
Persons on board:	Crew – 1 Passengers – 3
Injuries:	Crew – Nil Passengers – Nil
Damage to aircraft:	Serious

FACTUAL INFORMATION

On 12 September 2011 at about 0815 Central Standard Time[1], a Robinson Helicopter Co. R44 Astro helicopter, registered VH-HBA (HBA), departed Heartbreak Hotel, Northern Territory, for a local scenic flight with one pilot and three passengers onboard.

Prior to the flight, the pilot conducted a pre-flight inspection and determined that the aircraft was serviceable. The three 12 year old passengers were given a thorough safety brief prior to departure.

While on climb, approaching 1,500 ft above ground level, the pilot banked the helicopter left upon which the engine fire light illuminated. The pilot looked towards the rear of the helicopter but did not observe any signs of fire. He commenced a descent and selected a clearing to conduct a precautionary landing. Shortly before touchdown, the engine oil pressure light illuminated and the pilot observed a rapid loss of oil pressure. He also recalled smelling burning plastic.

After landing, the pilot conducted an emergency shut down and exited the helicopter. He observed small flames originating from under the engine cowling at the rear of the helicopter cabin. The pilot instructed the passengers to evacuate the helicopter. Two passengers were able to quickly release their seatbelts and open the door, while the third passenger required some additional guidance from the pilot.

The pilot moved the passengers to a safe area away from the helicopter and returned to retrieve the satellite phone. A portable fire extinguisher was onboard the helicopter, however the pilot determined that the fire was too well established to attempt to retrieve the fire extinguisher, which was stowed in the foot well on the passenger side.

The helicopter was destroyed in the fire (Figure 1). A subsequent ground fire broke out as a result of the accident.

The pilot notified the company and a nearby helicopter was dispatched to retrieve the pilot and passengers.

Figure 1: Accident site

Image courtesy of the operator.

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

Wreckage inspection

The operator retrieved the helicopter and conducted an inspection to determine the cause of the fire. The inspection found that all of the fittings for the fluid-lines were attached and suitably fastened. The exhaust system also appeared to be intact. Due to the extensive damage to the helicopter, the source of the fire was unable to be determined.

Helicopter maintenance

The helicopter had flown about 30 flight hours since its last scheduled maintenance activity and had reportedly been operating normally.

The pilot had spent the previous day cleaning the helicopter and repainting the blades. Oil was noted on the underside of the helicopter, although it was not thought to be excessive or unusual.

On the morning of the accident flight, the pilot conducted a pre-flight inspection with no abnormalities noted. There was a small amount of oil around the engine bay, although this was considered to be normal. One quart of oil was added to the engine prior to the flight. The pilot reported checking the oil cap security twice prior to departure.

Safety brief

The pilot had noted that during previous flights, passengers appeared to have difficulty operating the doors and seatbelts. He determined that in the event of an emergency, passengers may have difficulty evacuating the helicopter. In response to these observations, the pilot developed a comprehensive safety briefing. The pilot conducted that safety brief prior to departure. The brief included how to approach and exit the helicopter, both during normal operations as well as in emergencies. The pilot demonstrated the use of the doors and seatbelts and instructed the passengers to practice operating the doors and seatbelts several times prior takeoff. The brief also included the location of the first aid kit, satellite phone, emergency locator transmitter (ELT) and additional water. The pilot showed the passengers how to turn the satellite phone on and enter the pin code to activate the phone. The pilot also showed the passengers how to activate the ELT.

SAFETY MESSAGE

This incident highlights the importance of thorough pre-flight safety briefs. In this event, the pilot conducted a detailed demonstration as well as requiring the passengers to show him that they could operate the doors and seatbelts on their own. The pilot also showed the location of the additional safety features including the ELT and satellite phone, as well as demonstrating how they operated.

The 2006 ATSB safety research and analysis report B2004/0238, *Public Attitudes, Perceptions and Behaviours towards Cabin Safety Communications,* stated that the safety briefs, particularly when thoroughly and professionally delivered, increase the chances of survival for passengers. The report also cited the Federal Aviation Administration (FAA) as saying that safety information should be made as interesting and attractive as possible. Further information can be found at:

- Public Attitudes, Perceptions and Behaviours towards Cabin Safety Communications

www.atsb.gov.au/media/32927/b20040238.pdf

The pilot also commented that emergency equipment stored under the seat, or on the passenger side of the helicopter, was difficult to access in a fire. The satellite phone was on top of the instrument panel and able to be quickly retrieved, however all other equipment was destroyed in the fire. The pilot stated that in the future, consideration would be given to locating items like the fire extinguisher, first aid kit, ELT and emergency water in an area that could be easily reached during an emergency.

AO-2011-141: VH-AYP, Hard Landing

Date and time:	29 October 2011, 1745 ESuT	
Location:	Maitland Airport, New South Wales	
Occurrence category:	Accident	
Occurrence type:	Hard landing	
Aircraft registration:	VH-AYP	
Aircraft manufacturer and model:	Bell Helicopter Company 206 BII Jetranger	
Type of operation:	Flying training	
Persons on board:	Crew – 2	Passengers – Nil
Injuries:	Crew- Nil	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 29 October 2011, at about 1740 Eastern Daylight-saving Time[1] a Bell Helicopter Company, 206 BII Jetranger helicopter, registered VH-AYP (AYP), landed heavily at Maitland aerodrome during an autorotation[2] demonstration.

On board the aircraft were a flying instructor and student. The student had recently purchased the helicopter and was in the process of obtaining a private helicopter licence.

The instructor had spent the day instructing the student in various aspects of helicopter flight over several lessons. These lessons included a briefing followed by practical application in the following areas, hovering, taxiing, turns, transitions and circuits. The instructor intended that autorotation would be the subject of the next lesson at a later date, as the student had expressed some apprehension about practicing emergencies.

On returning to Maitland, the student was instructed to position AYP to make a straight in approach to runway 05 grass right. The instructor then informed the student that he would demonstrate how to enter autorotation.

At about 1000 ft above ground level (AGL) the instructor initiated the autorotation by stating "*3,2,1 engine failure*" the instructor then rolled the throttle off until the N1[3] was at 62% on descent. A stabilised autorotation was then established at 60 - 65 kts. The instructor then called on descent through 250 ft to 300 ft AGL , "*re-engaging throttle*."

The instructor then stated "*passing 50 ft starting to flare.*" The collective was adjusted to maintain the rotor revolutions per minute (RPM) within the green arc[4].

The instructor reported experiencing a long glide and thinking that the runway intersection was rapidly approaching. The flare was tightened further reducing the helicopter's forward speed to a fast walking pace. The instructor then levelled the helicopter at approximately 5 ft to 10 ft above the

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

2 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 alter steep 'glide path'. The rate of descent is reduced just before ground impact by an increase in collective pitch; this increases lift trading stored rotor kinetic energy for increased aerodynamic reaction of the blades, and should result in a gentle touchdown.

3 N1 - Rotational speed of the low pressure compressor in a turbine engine.

4 Low rotor r.p.m. does not produce sufficient lift, and high r.p.m. may cause structural damage, therefore rotor r.p.m. limitations have minimum and maximum values. A green arc depicts the normal operating range with red lines showing the minimum and maximum limits.

ground and raised the collective lever[5] in anticipation of a power termination[6]. However, the low rotor RPM horn and warning light activated. The rotor RPM decayed to approximately 90 percent. The instructor realised that power had not been fully restored as he had not fully opened the throttle, as required for a power termination. The instructor then moved the throttle approximately three to five millimetres to the full open position.

The helicopter settled towards the ground as the turbine engine power[7] increased. The helicopter yawed to the right approximately 30 degrees and rolled to the left allowing the heel of the left skid to contact the ground. The helicopter then bounced four times and continued towards the taxiway. The instructor stated that the helicopter skidded along with one skid on the grass and one skid on the bitumen surface. As a result of the ground impact, the helicopter sustained serious damage to the tail boom and skids (see Figure 1).

Aircraft information

The aircraft had 14,603.7 hours total time in service at the time of the accident. A review of the Maintenance Release indicated that the aircraft was serviceable at the time of the accident.

Meteorological information

No weather observations were available from Maitland Aerodrome. The Tocal Agricultural College's weather observations were however, obtained from the Bureau of Meteorology. Tocal Agricultural College was approximately 6 NM to the north-east of Maitland Aerodrome.

The following conditions were observed:

- At 17:30 EDT – The wind was 040 at 5kts gusting 7kts. The temperature was 28 °C.
- At 18:00 EDT – The wind was 020 at 5kts gusting 7kts. The temperature was 28° C.

Flight Instructor Information

The instructor held an Airline Transport Pilots Licence, with a current medical and Grade 1 Instructor Rating. He had 5,200 hours total flying experience, of which about 2,300 hours was instructional time. The instructor was endorsed on the Bell 206 series helicopter and had about 1,300 hours on type. The instructor was authorised to conduct training on the Bell 206 pursuant to the company's Air Operators Certificate.

The instructor reported averaging 8 hours sleep a night over the previous three days and reported flying about 4 hours on the day of the accident over a series of lessons. The instructor stated that he felt free from fatigue on the day of the accident.

However, the instructor reported feeling under a fair degree of personal and work related stress at the time due to a number of factors, including organisational responsibility, time pressures and conflict resolution.

ATSB COMMENT

The quality of decisions made in the cockpit is influenced by many factors including personality, aptitude, stress, fatigue and emotion[8]. Flying fitness is not just a physical condition. It also involves the mental fitness of the pilot to perceive, think and act to the best of their ability despite the effects of external influences.

Research by the US National Aeronautics and Space Administration (NASA) has shown that emotional factors are repeatedly present in aviation accidents. The ability to think clearly and act decisively is greatly influenced by feelings and emotions. A better appreciation of the effects of stress on performance can be limited by the tendency of pilots to under-report and probably to under-assess such effects.

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5 Raising the collective increases the pitch of the main rotor blades, increasing the effective lift produced.

6 Used during training to terminate an autorotation at a height above ground level, by restoring full engine power. Resulting in the helicopter coming to a hover above the ground.

7 When a turbine engine is accelerated, there is a noticeable delay between the time the throttle is opened to when the engine accelerates to operating rpm.

8 *Australian Helicopter Accidents 1969-1988 (1989) Bureau of Air Safety Investigation pg 11*

The following publications provide useful information on stress, performance and fatigue:

- *Pilot Fatigue a major risk in combating plague locusts – Aviation Transport Safety Bureau* (2011) www.atsb.gov.au/newsroom/news-items/fatigue -safety-alert.aspx
- *The Effects of Life-Stress on Pilot Performance NASA* (2008) http://human-factors.arc.nasa.gov/flightcognition/Publications/Young_TM2008_215375_final.pdf

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.

Helicopter operator

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

- Introducing the policy that all emergency training is to be briefed prior to being performed.
- Introducing the requirement for both instructor and student to complete the I'MSAFE fitness to fly personal checklist prior to each lesson.[9]

SAFETY MESSAGE

ATSB research indicates that for helicopters the greatest exposure for an accident or incident occurs during practice autorotations. Page 27 of research paper *Australian Helicopter Accidents 1969-1988*, published by the Bureau of Air Safety Investigation in 1989, included information that out of a total of 42 helicopter accidents analysed, 18 involved hard landings after a practice autorotation. A copy of the paper can be accessed at:

www.atsb.gov.au/media/704905/aust_helicopter_accidents.pdf

There are a number of factors that must be considered in planning and execution to achieve a successful outcome.

The following publications provide useful information on practice autorotations:

- *Planning Autorotations*- Federal Aviation Administration – www.faasafety.gov/gslac/alc/libview_normal.aspx?id=56414
- *Robinson Safety Notice SN-38* www.robinsonheli.com/srvclib/rhcsn-38.pdf Although specific to Robinson Helicopters the concepts are applicable to all autorotations.

[9] Dr David Newman in an article for the Civil Aviation Authority's (CASA) Flight Safety Australia magazine discusses methods pilot's can use to determine their fitness to fly. He suggests a useful method is the "I'M SAFE" checklist. This stands for; Illness, Medication, Stress, Alcohol, Fatigue and Eating The complete article is available at:

www.casa.gov.au/wcmswr/assets/main/fsa/1999/nov/fsa32-34.pdf

Figure 1: Damage to the tail boom and skids, VH-AYP

Photo courtesy of the operator

AO-2011-145: VH-CME, Collision with terrain

Date and time:	7 November 2011, 0630 EST	
Location:	93km north of Julia Creek, Queensland	
Occurrence category:	Accident	
Occurrence type:	Collision with Terrain	
Aircraft registration:	VH-CME	
Aircraft manufacturer and model:	Robinson Helicopter Company R22 Beta	
Type of operation:	Aerial Work – Mustering	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers –Nil
Damage to aircraft:	Destroyed	

FACTUAL INFORMATION

On 7 November 2011, at 0530 Eastern Standard Time[1], a Robinson Helicopter Company, R22 Beta (R22), registered VH-CME, was being used for a cattle mustering operation[2] on a station property about 93km north of Julia Creek, Queensland. The pilot was the sole occupant of the helicopter.

The helicopter was being operated over flat and sparsely-timbered terrain. The pilot's task was to locate and muster cattle within a paddock through a gate into the adjacent paddock.

At about 0630 EST the pilot called the ground crew on the radio and said that he had found a small herd of cattle in the paddock. The ground personnel at this time were located about 15 kms away and were occupied with other tasks.

The pilot elected to move the cattle without any assistance from the ground personnel. The pilot performed about six or eight turns up and down the fence line mustering the cattle through the gate. The pilot reported these cattle as being particularly difficult to move. Once the cattle had moved through the gate, the pilot reported feeling a sense of urgency "to get the gate closed" before the cattle had an opportunity to come back through it.

In manoeuvring the helicopter to land near the gate, the pilot performed "an aggressive left hand turn" at approximately 4 or 5 ft above ground level (AGL). The pilot estimated that he entered the turn at about 30 to 40kts, rolling the aircraft through to about 40 degrees angle of bank. During the turn, as the pilot was looking through the turn towards his intended landing point, the helicopter's main rotor blades struck the ground and the helicopter came to rest on its side (Figure 1).

The pilot was not injured, however the helicopter sustained serious damage.

Pilot information

At the time of the accident, the pilot held a commercial helicopter pilots licence with about 480 hours total time. The pilot's mustering experience included about 150 hours dual mustering and 200 hours mustering in command. All of the pilot's flying experience was in the R22.

It was only the second time that the pilot mustered that paddock from the air. However, the pilot had mustered that paddock several times from the ground.

Weather

The pilot reported the weather as fine with the wind from the north at 10 kts.

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

2 Aerial mustering is the locating, rounding up and movement of animals using an aircraft.

SAFETY MESSAGE

Pilot Confidence and Experience

The Transport Safety Board (TSB) Canada, publication *Human Factors for Aviation, Basic Handbook,* identifies that there is a particular danger period in a pilot's career when they have between 100 and 500 hours total time.

It would appear that a pilot's confidence during this period exceeds their experience and ability. As a result, pilots may unknowingly put themselves in situations that are beyond their capabilities having not developed the experience to recognise the level of danger involved.

The following publication provides further reading on pilot confidence and experience levels.

http://shop.tc.gc.ca/TChtml/ibeCCtpItmDspRte.jsp?JServSessionIdrootncras147=46rsubqqp1.pAbMmlaLb3qIr6aInQaImQ4UtxCLbx0Ta0--&item=40757

Task Fixation

The ability to maintain situational awareness while completing individual, separate tasks is one of the most critical aspects of working in the aerial stock mustering environment. Preoccupation with one particular task can degrade the ability to detect other important information. Fixation can happen even to experienced pilots who have mastered those individual tasks.

On this occasion, the pilot reported feeling a sense of urgency to close the gate. This sense of urgency was a consequence of the lack of assistance available from the ground. The pilot was concerned that the cattle, if given the opportunity, would come back through the gate.

Decision making and risk management

Mustering the paddock with no assistance from ground personnel increased the level of risk of the operation. Mustering at low level has an inherent risk profile that requires a high level of awareness by the pilot. Pilots should ensure that the decisions that they make are with a view of minimising this risk profile.

Apart from the Civil Aviation Safety Authority's (CASA) regulatory framework, there is little to guide mustering pilots towards achieving the goal of risk as low as reasonably possible (ALARP). Risk management is an important component of aeronautical decision making (ADM). When a pilot follows good decision-making practices, the inherent risk in a flight is reduced. The ability to make good decisions is based upon direct or indirect experience and education. That is, good judgment can be taught and is not necessarily a by-product of experience.

Chapter 17 of the Federal Aviation Administration (FAA) Pilot Handbook discusses steps for good aeronautical decision-making which include:

- Identifying personal attitudes hazardous to safe flight.
- Learning behaviour modification techniques.
- Learning how to recognize and cope with stress.
- Developing risk assessment skills.
- Using all available resources.
- Evaluating the effectiveness of one's ADM skills.

For further reading on that publication go to:

www.faa.gov/library/manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2017.pdf

The July-August 2011 edition of CASA's *Flight Safety Australia* included an article on aerial agriculture. The article 'Reaping the Whirlwind' included discussion on low-stress stock handling and the importance of helicopters being used more strategically and in combination with other tools including motorbikes, horses and dogs. This emerging mindset not only maximises the wellbeing of the livestock but also reduces the risk associated with the operation. Low-stress mustering by helicopter usually sees the machine flying slowly at an altitude of 400ft AGL some distance from the cattle.

- *Reaping the Whirlwind*. Flight Safety Australia(81), 8-15 www.casa.gov.au/wcmswr/assets/main/lib100059/jul-aug11.pdf

Figure 1: Accident site, VH-CME

Photo courtesy of the operator

AO-2011-152: VH-RKN, Hard Landing

Date and time:	27 November 2011, 1200 WST	
Location:	El Questro Station	
Occurrence category:	Accident	
Occurrence type:	Hard landing	
Aircraft registration:	VH - RKN	
Aircraft manufacturer and model:	Robinson R22 Beta II	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage to aircraft:	Serious	

FACTUAL INFORMATION

On 27 November 2011, at 1100 Western Standard Time[1] a Robinson Helicopter Company R22 Beta II, registered VH-RKN (RKN), departed Kununurra, Western Australia (WA) on a private flight. The pilot was the sole occupant of the helicopter.

The purpose of the flight was a general stock check of a station property approximately 56 km to the west of Kununurra.

At about 1200 WST, the helicopter was being operated over relatively flat, scrubby, terrain. The pilot was heading in a southerly direction at about 200 ft above ground level (AGL) when he noticed what appeared to be an injured bull. The pilot decided to land for a closer inspection of the bull.

The pilot located a suitable landing area to the west of his position and commenced a right turn at about 20 kts indicated airspeed. The pilot rolled out of the turn on a north-westerly heading, and the low rotor revolutions per minute (RPM) light and horn activated[2]. The pilot stated that, at the time the low RPM horn and light activated, he was at about 50 ft AGL. The pilot stated that he immediately lowered the collective[3], however he was unable to recover the rotor RPM nor arrest the rate of descent.

The pilot flared the helicopter by raising the collective to cushion the helicopter with the remaining rotor RPM on to the ground. However, the helicopter landed heavily and as a result sustained serious damage to the skids (Figure 1). The pilot was uninjured.

Weather

The METAR[4] report for Kununurra at the time was;

- Wind 080 at 6 to 10 kts,
- Temperature of 36.2 °C
- Dew point of 16.3 °C.
- Barometric pressure 1007.6 hPa

The density altitude[5] was calculated to be 2770 ft.

The relative humidity was calculated to be about 31%.

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

2 The low RPM light and horn indicate rotor RPM at or below 97%.

3 Decreasing the collective decreases the pitch of the main rotor blades, decreasing rotor drag and decreasing the effective lift produced.

4 Routine aerodrome weather report issued at fixed times, hourly or half hourly.

5 Pressure altitude corrected for non-ISA temperature.

Helicopter performance

The pilot reported that the power setting required to hover the helicopter in ground effect on departure from Kununurra was about 23 inches manifold air pressure, which was close to the placarded limit manifold air pressure for takeoff of 23.9 inches.

The out of ground effect hover[6] performance for the helicopter was calculated. Based on the ambient conditions and the helicopter's gross weight at the time of the accident, the performance data indicated that the helicopter was capable of an out of ground effect hover.

In general, as the density altitude increases, helicopter rotor and piston engine performance decrease. Ambient wind conditions can also have significant and differing effects on the performance of helicopters equipped with a tail rotor. The performance data provided in the R22 helicopter's flight manual is only valid for nil-wind conditions and does not account for the adverse effects of high relative humidity.

Pilot experience

The pilot had about 228 hours flying experience, of which about 158 hours were in command. The majority of the pilot's experience was in the Robinson R22 helicopter and was evenly distributed between the Beta 1 and Beta 2 variants.

The pilot reported that during flight training, he had not experienced the helicopter being close to limits of power and had not previously experienced low main rotor RPM. He also reported that at the time of the accident, he was not aware of the need to manually roll on the throttle in a piston engine machine to recover from a low RPM situation.

SAFETY MESSAGE

Low rotor RPM

Robinson Helicopter Company has identified low rotor RPM as a significant factor in fatal helicopter accidents.

In simple terms, low rotor RPM is a product of insufficient engine power relative to the engine power required. A lack of engine power can be due to a number of reasons including complete engine failure, a partial power loss, the ambient conditions, or pilot technique.

The following publications provide useful information on low rotor RPM avoidance and recovery procedures:

- *Robinson Safety Notice SN-10* - Fatal accidents caused by low rotor RPM Rotor Stall *www.robinsonheli.com/srvclib/rchsn10.pdf*
- *Robinson Safety Notice SN-24* - Low rotor RPM rotor stall can be fatal *www.robinsonheli.com/srvclib/rchsn24.pdf*
- *Robinson Safety Notice SN-34* – Aerial survey and photo flights very high risk *www.robinsonheli.com/srvclib/rchsn34.pdf*

Helicopter training syllabus

ATSB report, AO-2008-062, *Collision with terrain, 6 km NE of Purnululu ALA, Western, Australia,* 14 September 2008, identified a safety issue with the Helicopter Training Syllabus. The issue identified was that there was no Australian requirement for endorsement and recurrent training conducted on Robinson Helicopter Company R22/R44 helicopters to specifically address the preconditions for low rotor RPM or the recovery procedure.

- Report AO-2008-062 is available at; www.atsb.gov.au/media/1533519/ao2008062.pdf

The Civil Aviation Authority (CASA) project; OS 11/52 Amend CAO 40.3.0 Appendix 2 - *Requirement for Awareness Training (AT) to be conducted as part of endorsement* 19 December 2011, will be reviewing the requirements for initial pilot training and endorsement and recurrent training on all helicopters. This would include a review of the Helicopters Flight Instructors Manual.

- Project OS 11/52 is available at: www.casa.gov.au/scripts/nc.dll?WCMS:PWA::pc=PC_100815

[6] Helicopters require more power to hover out of ground effect due to the absence of a cushioning effect created by the main rotor downwash striking the ground. The distance is usually defined as more than one main rotor diameter above the surface.

Figure 1: Accident site, VH-RKN

Image courtesy of the operator

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Short Investigation Belletin
Fourth Quarter 2011
AB-2012-019
Final