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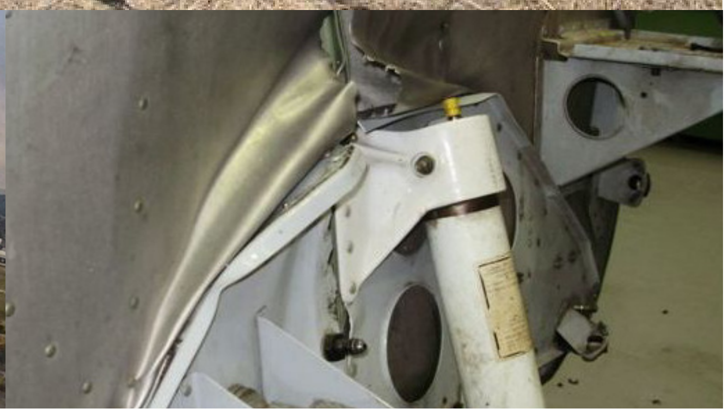
Aviation Short Investigation Bulletin

Issue 13



Investigation

ATSB Transport Safety Report

Aviation Short Investigations

AB-2012-141

Final

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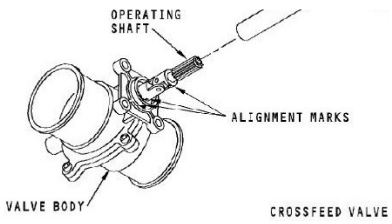

Source: **The Boeing Company**

On 15 April 2012 at 1302 Eastern Standard Time[1], a Virgin Australia Boeing 737 aircraft, registered VH-VOL (VOL), departed Gold Coast Airport, Queensland on a scheduled flight to Melbourne, Victoria. During climb, the crew observed that both engines were being supplied fuel only from the right fuel tank. This resulted in a fuel quantity difference between the left and right fuel tanks. In response, the crew executed the fuel leak engine checklist[2] which confirmed that no engine fuel leak existed. With centre tank fuel available, the crew selected the centre fuel tank pumps on, which resulted in the fuel imbalance stabilising. As the crew were unable to confirm that fuel from the left tank could be used once the centre tank pumps were selected off, or that no fuel leak existed, they elected to divert to Brisbane, Queensland and declare a PAN[3].

Once tracking to Brisbane had been established, the Captain confirmed with air traffic control that operations were normal, and a normal approach and landing was expected. The aircraft landed overweight on Runway 19 without further incident. After landing, Airport Emergency Services conducted a visual inspection of the aircraft as a precautionary measure, and escorted the aircraft to the terminal bay.

Engine fuel feed - crossfeed valve

Due to operational requirements, there was a delay in the departure of VOL from the Gold Coast Airport. During that period, the crossfeed valve[4] was selected open and centre tank pumps configured to prevent a fuel imbalance as a result of extended ground operations. Prior to departure, the aircraft was reconfigured for flight, which included the crossfeed valve being selected closed. The operation of the crossfeed valve, as indicated by the crossfeed valve open light was normal.

Previous incidents

Boeing had received several reports from operators relating to fuel imbalance occurrences during flight on 737-800 and -900 series aircraft. These aircraft had accumulated between 22,928 and 27,390 hours in service when the imbalances were reported and the flight crew were able to correct the imbalance using existing procedures. Investigations identified excessive wear in the crossfeed valve disk spline, which prevented the valve from fully closing that resulted in valve leakage. Boeing determined the wear did not represent a safety issue because the condition was indicated to the crew as a fuel imbalance before the valve performance degraded to the point that the crossfeed valve could not be opened when required. In September 2010, Boeing issued service letter 737-SL-28-073-B which introduced a modified valve body assembly, and recommended action for operators to address crossfeed valve leakage occurrences.

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

2 In the event of abnormal system operation the flight crew refer to Flight Crew Operations Manual - Quick Reference Handbook (QRH) for procedural requirements.

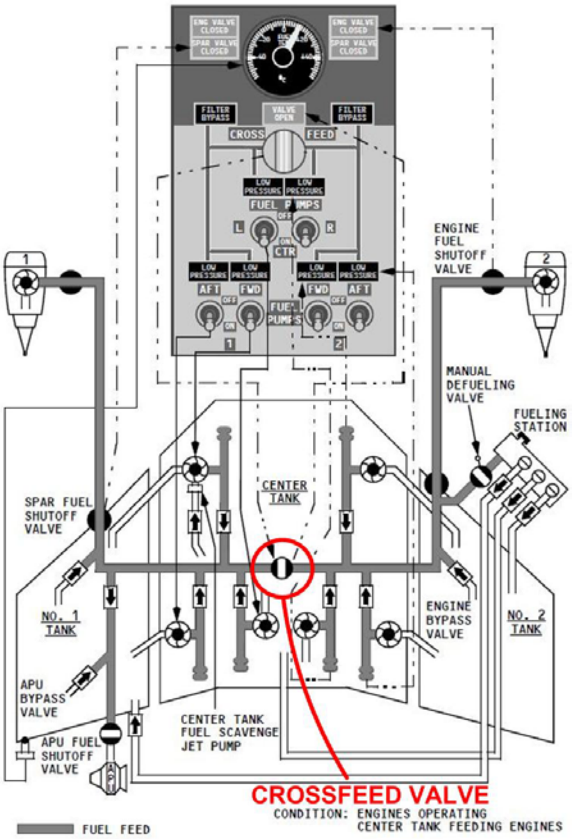
3 An internationally recognised radio code announcing, an urgent condition which concerns the safety of an aircraft or its occupants, but where the flight crew does not require immediate assistance.

4 The crossfeed valve enables fuel flow between the left and right engine manifolds when the crossfeed valve is open (normal position is closed). With the connection of the two engine fuel feed manifolds, one fuel tank supplies fuel to both engines.

VOL crossfeed valve examination

The crossfeed valve was installed on VOL since manufacture. At the time of the occurrence, the aircraft had a total time in service of 31,858 hours. Due to the reported history of crossfeed valve malfunction, the valve was removed from the aircraft and dispatched to an overhaul organisation for rectification. The subsequent inspection identified wear to the sealing materials and Teflon within the valve body as consistent with the existence of a leak within the valve. However, the overhaul organisation was unable to confirm whether the sealing material degradation would explain a high volume fuel leakage rate. The condition of the valve spline was not identified. The worn sealing material and Teflon was replaced by the overhaul organisation with the incorporation of the modified valve body assembly.

Figure 1: Fuel system schematic



Source: ***The Boeing Company***

Safety action

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

Operator

Virgin Australia Airlines had previously established an inspection program for the crossfeed valves in accordance with Boeing recommendations.

The operator also has a program in place to replace existing crossfeed valves with the modified version at scheduled maintenance servicing. This program is currently under review for acceleration.

Aircraft details

Occurrence category:	Incident	
Occurrence type:	Operational - Fuel related	
Registration:	VH-VOL	
Manufacturer and model:	Boeing Company 737-8FE	
Type of operation:	Air Transport High Capacity	
Persons on board:	Crew – 6	Passengers – 171
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Breakdown of separation – Boeing 737-438 VH-TJS and Fairchild SA227 VH-MYI

AO-2012-087

What happend

On 21 June 2012, at 1718:53 Eastern Standard Time[1], a breakdown of separation (BOS) occurred between a Qantas Airways Boeing 737-438 (B737), registered VH-TJS (TJS) and a Sharp Aviation Fairchild SA227, registered VH-MYI (MYI) near Melbourne Airport, Victoria.

TJS had earlier departed Sydney, New South Wales for Melbourne Airport, with the first officer as the flying pilot, while MYI was operating from Orange, New South Wales to Essendon Airport. Essendon Airport was located about 5 NM (9 km) south-east of Melbourne Airport. Both aircraft were conducting scheduled passenger services.

The captain of TJS reported that they were initially issued arrival instructions for runway 34 however the arrival runway was later changed to runway 27. TJS was subsequently issued with a series of radar vectors and speed control instructions by Air Traffic Control for sequencing with other aircraft, including MYI.

At 1717:44, the approach controller (controller) instructed TJS to turn right to a heading of 230˚. At 1717:55, the controller instructed TJS to '...descend to three thousand you're cleared ILS[2] runway 27 approach'. At that time, MYI was inbound to Essendon Airport and located about 6 NM to the south-south-east of TJS (Figure 1).

Figure 2: Relative positions of TJS and MYI at 1717:55

Source: Airservices Australia

Both TJS and MYI were subsequently issued further speed reductions and at 1718:45, TJS was approaching the runway 27 localizer (Figure 2). The separation between the two aircraft at this time was 3.1 NM horizontal and 1,200 ft vertical. However, instead of intercepting the runway 27 localizer, TJS continued through the localizer and, at 1718:53, the controller asked TJS if they were turning right to intercept final. The separation between the two aircraft at that time had reduced to 2.9 NM horizontal and 1,100 ft vertical. In an attempt to maintain the required

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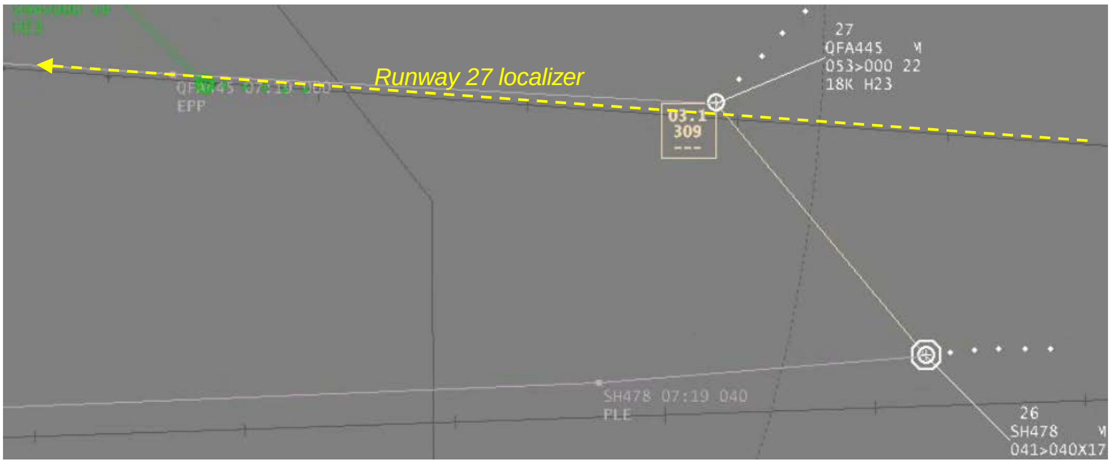
1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours.

2 A standard ground aid to landing, comprising two directional radio transmitters: the localizer, which provides direction in the horizontal plane; and the glideslope, for vertical plane direction, usually at an inclination of 3°. Distance measuring equipment or marker beacons along the approach provide distance information.

separation of 3NM horizontal or 1,000 ft vertical, the controller then reiterated that he needed TJS to turn right and issued MYI with a traffic alert and an instruction to turn left heading 180˚.

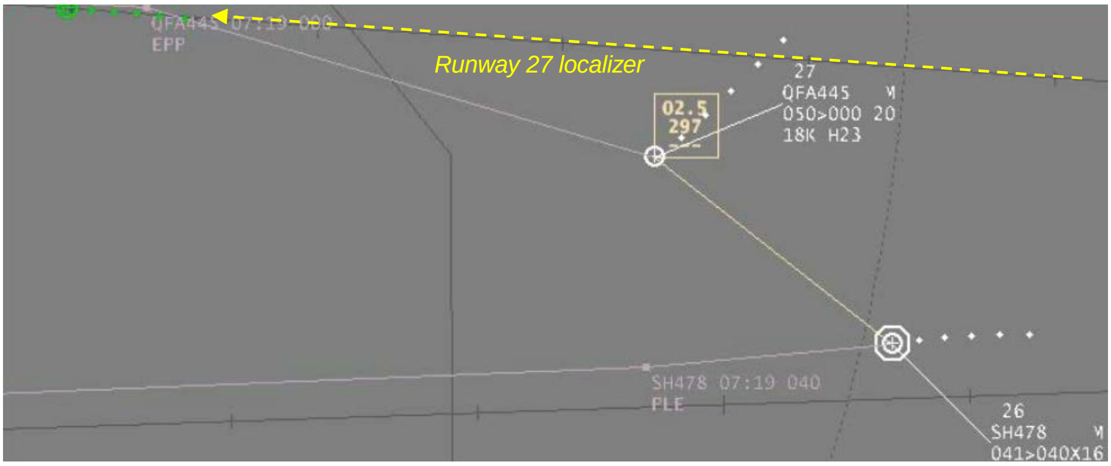
Figure 3: Relative positions of TJS and MYI at 1718:45



Source: Airservices Australia

At 1719:10, the controller issued TJS with a traffic alert for MYI and instructed TJS to turn right to a heading of 300˚ to intercept final from the left. TJS was now located about 1 NM to the south of the runway 27 localizer. Separation with MYI had reduced to 2.5 NM horizontal and 900 ft vertical (Figure 3).

Figure 4: Relative positions of TJS and MYI at 1719:10



Source: Airservices Australia

TJS subsequently intercepted the localizer from the left and landed at Melbourne Airport. MYI received additional radar vectors before returning to land at Essendon Airport.

Approach clearance

Following radar vectors, standard approach clearance phraseology includes advice regarding the aircraft's relative position, a suitable heading and intercept instruction, and a clearance to conduct the approach. As an example, the preceding aircraft was issued with the instruction, '...you're two and a half miles north of the localizer, turn right heading two three zero to intercept, cleared ILS runway 27 approach...'.

The controller reported that, while consideration was given to using a shallower intercept heading for TJS, the heading of 230˚ had worked well for the preceding aircraft and that it suited the sequence. Although the instructions issued at 1717:43 and 1717:55 did not include the aircraft's relative position or an instruction to intercept, they did include a clearance to conduct the ILS approach.

Approach controller information

The controller's operational experience included about 4 years as an approach controller, and 5 years as a tower controller. The controller reported that on the day of the occurrence, the winds were from the north and quite strong. The controller noted that high winds from the north impacted workload due to their effects on aircraft speeds. Aircraft arriving from the north would have tailwinds while aircraft arriving from southerly directions would have headwinds. As a result, a lot of aircraft required radar vectors and speed control for sequencing.

TJS Flight crew information

Both flight crew members of TJS had attained considerable experience operating the B737. The captain had been with the aircraft operator for about 20 years and had spent the majority of that time on the B737, while the first officer had been on the aircraft type for about 10 years.

The flight crew noted that the flight was delayed out of Sydney and reported that there were numerous calls en-route to the operator relating to passengers and connecting flights. They reported that they had discussed the approach clearances, noting that they were 'unusual' in that they did not include their aircraft's relative position or an instruction to intercept the localizer. However, despite their 'unusual' nature, the flight crew had understood the intent of the clearances and had intended to intercept the runway 27 localizer.

About 1-2 NM north of the localizer, the captain recalled noting that VOR/LOC[3] was not armed and thought that the first officer had subsequently armed it. However, the first officer could not recall if the VOR/LOC was armed or observing any movement of the course deviation indicator (CDI) prior to crossing the localizer.

The first officer remembered being 'loaded up' while complying with the latest speed reduction, and considered that this and the conversation about the non-standard ILS clearance may have contributed to them going through the localizer. When questioned by the controller as to why they went through the localizer, the captain replied that '...it didn't capture and (that) it was late notice (the approach clearance)...'

The first officer reported that the 737-400 could be slow to intercept the localizer, particularly with a tail wind. This was usually overcome by manually reducing the intercept angle as they approached the localizer.

Recorded information

Information from the aircraft's quick access recorder (QAR) was downloaded and analysed by the Australian Transport Safety Bureau. That information, in conjunctions with information from Airservices Australia, was used to develop the following sequence of events (Table 1).

3 In this case, if VOR/LOC mode was armed, the aircraft should have intercepted and tracked via the runway 27 localizer. Alternatively in approach (APP) mode, the aircraft would intercept both the localizer and glide slope.

Table 1: Sequence of events

Time (EST)	Event	AFDS[4] mode/s	Heading (approx)	Separation	CDI[5] dots
1717:44	TJS was instructed to turn right heading 230	HDG SELECT[6]	190˚		
1717:55	TJS was cleared for the runway 27 ILS approach	HDG SELECT	230˚	5.8 NM 400 ft	
1718:24	TJS was instructed to reduce to final approach speed	HDG SELECT	230˚	3.8 NM 1,400 ft	3.7 R
1718:45	TJS is approaching the runway 27 localizer and should be turning right	HDG SELECT	230˚	3.1 NM 1,200 ft	0.7 R
1718:50	TJS intersected the runway 27 localizer	HDG SELECT	230˚	3.0 NM 1,100 ft	0
1718:53	The controller asks TJS if they are turning right for final	HDG SELECT	230˚	2.9 NM 1,100 ft	0.7 L
1718:59	CWS[7] is selected and the aircraft begins to turn right	CWS	230˚	2.7 NM 1,000 ft	1.5 L
1719:10	TJS was instructed to continue the right turn heading 300 to intercept final from the left	CWS and HDG SELECT	270˚	2.5 NM 900 ft	3.0 L
1720:00	Approach (APP) mode engages	APP and CWS	285˚		1.7 L
1720:07	VOR/LOC mode engages	APP, CWS and VOR/LOC	295˚		1.2 L
1720:52	The aircraft intercepts the glideslope (G/S)	G/S and VOR/LOC	275˚		0

ATSB comment

The breakdown of separation occurred at a time when both the approach controller and the flight crew were experiencing an elevated workload. The approach controller's use of non-standard phraseology had the potential to induce a degree of uncertainty and may have increased the flight crew's workload further. While the approach clearance did not include all of the standard elements, the flight crew stated that they had understood the intent of the clearance and that they had intended to intercept the runway 27 localizer.

The passage of the aircraft through the localizer was consistent with neither the VOR/LOC nor APP modes being armed at that time and may have been a consequence of the higher than usual flight crew workload. The subsequent intercept from the left, when APP and subsequently VOR/LOC modes engaged, was consistent with normal operation of the system.

[4] Auto pilot flight director system

[5] In this case, the course deviation indicator (CDI) provided a visual indication to the flight crew of the localizer's position relative to the aircraft in 'dots' left (L) or right (R). At the occurrence distance, 1 'dot' was equal to about 0.3 NM (555 m).

[6] In this case, in HDG SELECT mode, the aircraft will fly the flight crew selected heading.

[7] In this case, control wheel steering (CWS) mode indicates that the pilot is manually manipulating the aircraft's flight control column to make adjustments to the aircrafts heading.

Although the separation between the two aircraft reduced to below the required standard, the approach controller's recovery actions ensured the separation standard was quickly restored.

Safety message

Standard phraseology is designed to ensure that communications between air traffic controllers and flight crews are clear and concise. Communications that do not adhere to the accepted standard have the potential to cause confusion, radio congestion and adversely affect the workload of both pilots and controllers.

While automation can greatly reduce flight crew workload, the need to constantly monitor the aircraft's flight path, particularly during critical stages of flight, is paramount. As the level of automation increases, so does the dependency and expectation that it will perform as expected.

Whereas this occurrence appears to be an isolated incident, there have been other instances that have provided examples of how a breakdown in the flight crew/automation interface can affect flight safety. Additional information about those occurrences can be found in the US Federal Aviation Administration publication, *The Interfaces Between Flight crews and Modern Flight Deck Systems* and the Fight Safety Foundation article on *Automated Cockpit Guidelines (OGHFA BN)*.

- The Interfaces Between Flight crews and Modern Flight Deck Systems
  www.faa.gov/aircraft/air_cert/design_approvals/csta/publications/media/fltcrews_fltdeck.pdf
- Automated Cockpit Guidelines
  www.skybrary.aero/index.php/Automated_Cockpit_Guidelines_(OGHFA_BN)

Aircraft details

Manufacturer and model:	VH-TJS: Boeing 737-438 VH-MYI: Fairchild SA227	
Operator:	VH-TJS: QANTAS VH-MYI: Sharp Aviation	
Registration:	VH-TJS VH-MYI	
Type of operation:	VH-TJS: Air transport –high capacity VH-MYI: Air transport –low capacity	
Location:	28 km E of Melbourne Airport	
Occurrence type:	Breakdown of separation	
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

Turboprop aircraft

Partial pilot incapacitation – Raytheon B200, VH-MSH

AO-2012-100

What happened

On 5 August 2012, at about 1400 Eastern Standard Time[1], an aeromedical pilot arrived at Sydney Airport, New South Wales to commence the 1400-2200 shift. At that time, the pilot reported that he was feeling tired and elected to have a 45 minutes sleep, after which he stated he felt fine.

Source: *Federal Aviation Administration*

The pilot and a flight nurse were then tasked with transporting a patient from Port Macquarie, New South Wales to Sydney. While preparing the Raytheon B200 aircraft, registered VH-MSH, for the flight, the nurse reported that the pilot did not appear his usual self. The nurse asked the pilot how he was feeling and she recalled that he initially stated that he felt ‘average’, but soon after, said he felt ‘okay’. The pilot reported that he was feeling emotionally drained at the time due to personal circumstances, although he felt physically fine prior to departing.

The flight departed Sydney at about 1600.

During the climb, the pilot reported that he began to feel unwell, experiencing abdominal pain and nausea. When overhead Newcastle, at about flight level (FL)[2] 210, the pilot’s condition worsened and he requested a sick bag from the nurse. The nurse also noticed that the pilot appeared pale in colour and suggested that he don his crew oxygen mask, which he did. The nurse then confirmed that the aircraft’s cabin pressure was normal, placed a pulse oximeter on the pilot to monitor his heart rate[3], and provided him with a drink. The pilot reported that his condition improved.

While they were positioned about 10 NM to the south-west of Williamtown Airport, the pilot elected to return to Sydney. The pilot reported that he was feeling better at the time, and they were only 60 NM from Sydney[4].

At about 1624, the pilot advised air traffic control (ATC) that they were returning to Sydney. Air traffic control asked if operations were normal, to which the pilot replied he was feeling unwell. The pilot reported that he did not see a requirement to broadcast a ‘PAN[5]’ call as his condition had improved. At about the same time, the nurse contacted the aeromedical operations centre via satellite phone to advise them of the situation.

At about 1628, ATC advised the pilot that Williamtown was closer if conditions were urgent. The pilot replied ‘understood’ and elected to continue to Sydney.

During the descent, passing through 6,000-7,000 ft, the pilot removed his oxygen mask. Soon after, when about 10-15 NM from Sydney, the pilot reported that he began to feel unwell again.

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

[2] At altitudes above 10,000 ft in Australia, an aircraft’s height above mean sea level is referred to as a flight level (FL). FL 210 equates to 21,000 ft.

[3] Pulse oximeter: A medical device that monitors an individual’s oxygen levels and pulse rate. The nurse reported that the pilot’s heart rate was considered normal.

[4] A diversion to Williamtown would have required the pilot to conduct a fast descent from FL210, which he believed would not have been operationally ideal.

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

At about 1647, the aircraft landed at Sydney.

After shutdown, the pilot became physically ill. He remained in the aircraft for about 10 minutes before moving inside the medical provider's facilities to lie down. He was assessed by medical personnel, who conducted an electrocardiogram (ECG)[6] and tested his blood pressure and sugar levels, which were reported as normal. The pilot rested for several hours before being transported home.

The pilot recovered from the illness about 1 week later. It was determined that he most likely suffered viral gastroenteritis.

Communications

Internal communications between the pilot and nurse were through the aircraft's intercom system, while external communications for the rear of the aircraft could be supplied through the copilot's communication system. The nurse stated that she could hear radio calls made by the pilot to ATC, but was unable to hear broadcasts made by ATC as the copilot's communication system was not turned on at the time. This reduced her awareness of the situation and her ability to confirm operations were normal.

Pilot comments

The pilot provided the following information regarding the incident and his personal history:

- The incident shift was initially intended for training on a new aircraft system, however, the aircraft was unavailable. The operator's check and training pilot, who was to carry out the training, offered to conduct the return flight to Port Macquarie on behalf of the pilot if he felt unwell. However, as the pilot felt much better after having a 45 minute sleep, he elected to conduct the flight.
- His current roster was not standard due to the scheduled training. He had worked from 1600 to midnight on 3 August and 1600 to 2200 on 4 August, and then travelled 1.5 hours to his home afterwards. The pilot stated that this was fatiguing.
- His quality of sleep for the previous three nights was 'average'.
- He had been experiencing a fair amount of stress as a result of his personal circumstances.

Flight nurse comments

The nurse indicated that the provision of crew resource management (CRM) training would have assisted in developing a suitable plan of action if the pilot's conditioned had worsened. Furthermore, the nurse commented that, it would have been beneficial to receive training on using the aircraft's communication system and talking to ATC, in the event of pilot incapacitation.

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.

Medical provider

As a result of this occurrence, the medical provider has advised the ATSB that they have requested the aircraft operator accelerate the provision of CRM training for flight nurses and include the activation of the copilot's communication system as part of that training.

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6 ECG is a diagnostic tool that is used to assess the electrical and muscular functions of the heart.

Aircraft operator

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

- Issued a memo reminding all pilots to ensure that the radios on the copilot's communication panel are turned on at all times to allow medical staff to monitor communications, in particular, during an emergency.
- Scheduled CRM training for November 2012.
- Reminded all pilots of their responsibilities with regard to fitness to fly. This will be further highlighted in the next edition of the operator's *Flight Safety Newsletter* and during the CRM training.

Safety message

Incapacitation may be subtle, or sudden, partial or complete; it may be due to the effects of a pre-existing medical condition, the development of an acute medical condition, or some physiological event.

Research published by the ATSB determined that the majority of pilot incapacitation events between 1 January 1975 and 31 March 2006 did not involve a chronic or pre-existing medical condition. That is, they were largely unforeseeable events.

However, while pilots conduct a pre-flight inspection of their aircraft to determine airworthiness, this incident highlights the importance of pilots also assessing their own well being. Tools such as the 'I'm safe checklist' allows pilots to determine if they are physically and mentally prepared for a flight by asking a number of questions relating to illness, medication, stress, alcohol, fatigue and eating (Figure 1). This checklist was also published in the aircraft operator's January 2011 *Flight Safety Newsletter*.

The following publications provide additional information on pilot incapacitation and the 'I'm safe checklist':

- Pilot Incapacitation: Analysis of Medical Conditions Affecting Pilots Involved in Accidents and Incident – 1 January 1975 to 31 March 2006 www.atsb.gov.au/media/29965/b20060170.pdf
- Federal Aviation Administration Risk Management Handbook www.faa.gov/library/manuals/aviation/media/FAA-H-8083-2.pdf
- I.M S.A.F.E. Checklist www.ampl.ma/attachements/publication/509.pdf

Figure 5: I'M SAFE checklist

Source: *Federal Aviation Administration (United States)*

Aircraft details

Manufacturer and model:	Raytheon Aircraft Company B200	
Registration:	VH-MSH	
Type of operation:	Aerial work	
Location:	10NM SW of Williamtown Airport, New South Wales	
Occurrence type:	Crew incapacitation (partial)	
Persons on board:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Nil	

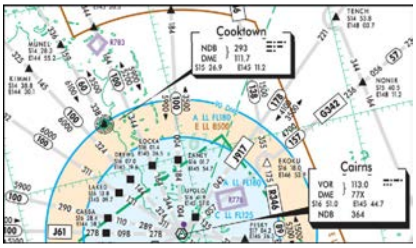
Breakdown of separation - Beech 200, VH-FDD and Beech 350, DINGO 008

AO-2012-101

What happened

On 9 August 2012, a Raytheon Beech 350 aircraft, operating under the callsign DINGO 008, was conducting a military flight from Northern Peninsula Aerodrome, Queensland to Townsville, Queensland, under the Instrument Flight Rules (IFR)[1]. The aircraft was flight planned to track south, overhead Cooktown and Cairns, at flight level (FL)[2] 270.

Location of airspace



Source: Airservices Australia

At 1205 Eastern Standard Time[3], a Raytheon Beech 200 aircraft, registered VH-FDD (FDD) and operating under the callsign FLYDOC 423, departed Cairns, tracking north for Horn Island, Queensland, on climb to FL260. Due to other aircraft inbound to Cairns from the north, air traffic control (ATC) vectored FDD right of the aircraft's flight planned track. About 15 minutes later, enroute ATC cleared FDD to track direct to position KIMMI[4] to rejoin the aircraft's flight planned route.

At 1231:22, as FDD was passing FL255, the pilot requested further climb to FL300. The air traffic controller advised the pilot to stand by then commenced the required coordination with the two northern ATC sectors and the associated inputs into the Australian Advanced Air Traffic System (TAAATS). At 1232:15, the controller assigned FDD further climb, which resulted in a loss of separation assurance (LOSA)[5] with DINGO 008. At that time, FDD was passing FL259 and was 28.2 NM (52.2 km) south of DINGO 008, maintaining FL270 (Figure 1). There was about 2.8 NM (5.2 km) between the projected flight paths of the aircraft.

1 Instrument flight rules (IFR) permit an aircraft to operate in instrument meteorological conditions (IMC), which have much lower weather minimums than visual flight rules. Procedures and training are significantly more complex as a pilot must demonstrate competency in IMC conditions, while controlling the aircraft solely by reference to instruments. IFR-capable aircraft have greater equipment and maintenance requirements.

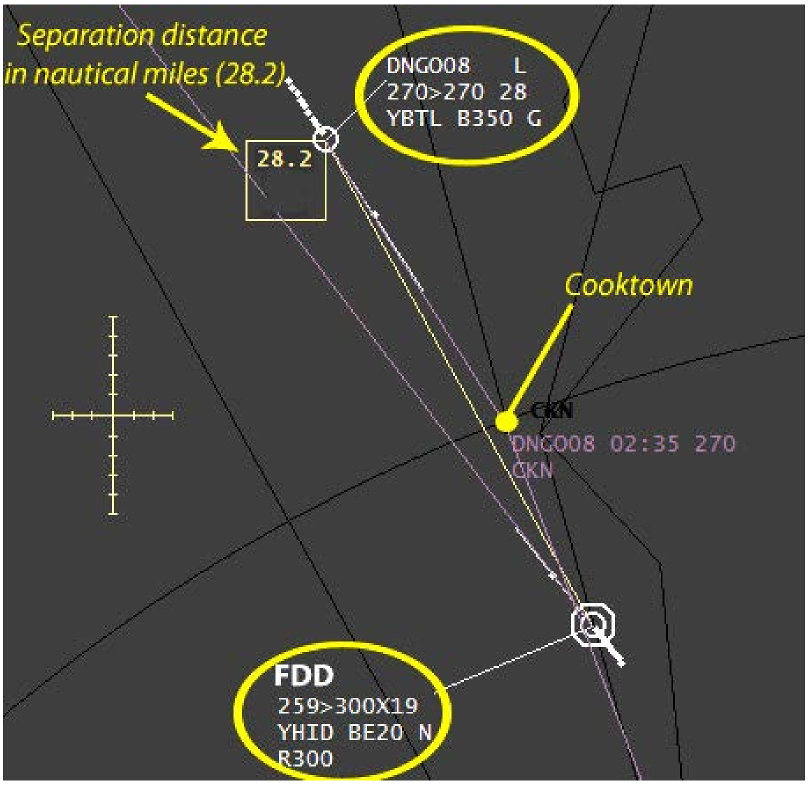
2 At altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 270 equates to 27,000 ft.

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

4 KIMMI was an Instrument Flight Rules waypoint.

5 A separation standard existed; however, planned separation was not provided or separation was inappropriately or inadequately planned. See also 'ATSB comment' section.

Figure 6: Proximity of the aircraft at 1232:15

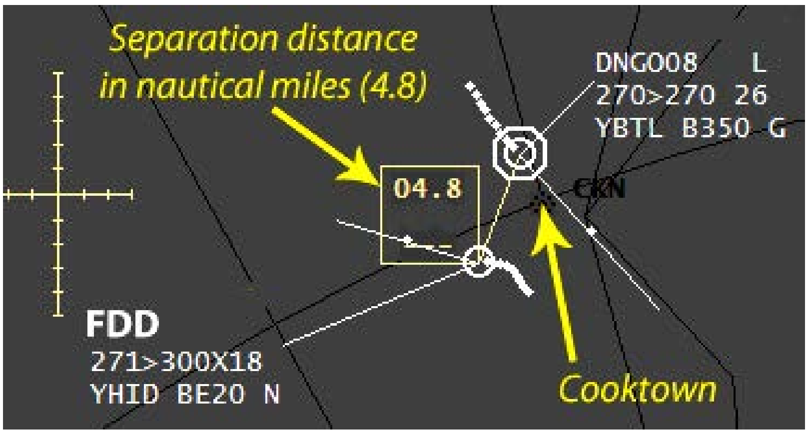


Note: Each graduation on the scale marker is 1 NM (1.85 km)
Source: *Airservices Australia*

At about 1232:30, the TAAATS Short Term Conflict Alert (STCA) activated on the controller's console. There was 10.1 NM (18.7 km) horizontally and 200 ft vertically between FDD and DINGO 008. The controller immediately issued the flight crew of FDD with a traffic alert, including the position of the other aircraft and an instruction to turn left onto a heading of 270°, which was acknowledged. The controller then issued a traffic alert to the flight crew of DINGO 008, with the position of FDD and an instruction to turn left onto a heading of 090°, which was acknowledged.

At 1235:25, a breakdown of separation occurred as the distance between the aircraft reduced to 4.9 NM (9.1 km) with both aircraft at FL270. The distance reduced further to 4.8 NM (8.9 km) with FDD 100 ft above DINGO 008 (Figure 2), before increasing three seconds later to the required radar separation standard of 5 NM (9.2 km) horizontally or 1,000 ft vertically.

Figure 7: Proximity of the aircraft at 1235:27



Note: Each graduation on the scale marker is 1 NM (1.85 km)
Source: *Airservices Australia*

The pilot of FDD subsequently reported to the controller that they had sighted and passed DINGO 008. The aircraft involved were both equipped with Airborne Collision Avoidance Systems (ACAS)[6] and no ACAS alerts were generated. The flight crew of FDD later reported that they had sighted the other aircraft on their ACAS, after the controller issued the clearance to climb to FL300, and had visual contact when DINGO 008 passed them. The flight crew of DINGO 008 reported that they sighted FDD on their ACAS and were visually able to identify the traffic to ensure that there was no imminent collision risk.

Air traffic control

The air traffic controller involved in the occurrence had about 23 years experience in ATC, with all of their control experience incorporating the airspace sector on which the incident occurred. On the day of the occurrence, the controller was working a 0600 to 1430 shift, which was the last morning shift in a series of three, before two rostered days off. The controller reported that they were fatigued but considered themselves fit for duty. The loss of separation event was about 15 minutes after the controller had returned from a rest break and around two hours before the shift finished.

The controller reported that prior to the level change request from FDD's pilot, the workload had been high with a moderate degree of complexity, then reduced. The controller was trying to expedite the process required to get clearance for FDD to climb to the amended level, so the pilot would not have to level the aircraft at FL260. In doing so, the controller stated that their attention narrowed to that task. When they assigned further climb to FDD, they had not identified the potential conflict with the other aircraft. The controller's attention was then diverted with other tasks and they did not have an opportunity to reassess the separation between FDD and DINGO 008 before the STCA alerted them to the conflict. The controller reported that they were then surprised at the slow climb rate of FDD.

The controller had completed compromised separation recovery (CSR) refresher training a few months prior to the occurrence. The controller considered that their reaction to the STCA and subsequent safety alerts and control instructions were a result of CSR refresher training and ATC experience.

ATSB comment

When the controller assigned FDD further climb to FL300, there was a LOSA with DINGO 008, as the controller had not identified the confliction and therefore had not ensured that the required standards of either vertical separation of 1,000 ft or radar separation of 5 NM (9.2 km) would be maintained. To assure separation, the controller would have had to issue instructions to ensure that FDD was at or above FL280 before the distance from DINGO 008 reduced below 5 NM or that the tracks of the aircraft were separated by 5 NM.

In this occurrence, a critical system defence (the STCA) activated and alerted the controller to the LOSA situation. The compromised separation recovery techniques utilised by the controller were applied quickly and were an effective defence in limiting the severity of the breakdown of separation.

Safety message

This incident highlights the importance for controllers to effectively balance their professional desire to promptly facilitate pilot requests with the overriding requirement to provide a safe and efficient air traffic control service.

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[6] An Airborne Collision Avoidance System (ACAS) is an aircraft system that warns of the presence of other aircraft that present a threat of collision.

The prompt and effective controller reaction to re-establish the appropriate separation standard highlights the benefit of and importance of regular compromised separation recovery training as an integral defence.

Aircraft details

Manufacturer and model:	VH-FDD: Raytheon Aircraft Company BE20 DINGO 008: Raytheon Aircraft Company B350	
Registration:	VH-FDD Unknown	
Type of operation:	VH-FDD: Aerial work DINGO 008: Military	
Location:	3.5 NM (6.5 km) south west of Cooktown, Queensland	
Occurrence type:	Breakdown of separation	
Persons on board:	VH-FDD: Crew – 2 DINGO 008: Crew - 2	VH-FDD: Passengers – 1 DINGO 008: Passengers - 4
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Piston aircraft

Aircraft proximity event – Piper PA-34, VH-PWQ and Cessna R182, VH-JYG

AO-2012-071

Segment of Avalon airspace

Source: Airservices Australia

What happened

On 22 May 2012, a Piper PA-34-220T, registered VH-PWQ (PWQ), was being used to conduct training under the Instrument Flight Rules (IFR)[1] at Avalon airport, Victoria. At about 1600 Eastern Standard Time[2], the instructor was monitoring a student conduct an Instrument Landing System (ILS)[3] approach to runway 18 while another student observed.

At about the same time, a Cessna R182, registered VH-JYG (JYG), was cleared by air traffic control (ATC) to conduct a pipeline survey through the Avalon area under Visual Flight Rules (VFR)[4]. On board were the pilot and an observer. The survey required JYG to cross the extended centreline of runway 18, just south of the Princes Freeway (Figure 1). The survey flight was conducted once a month and, as it was not shown on any aeronautical chart, the operator had previously provided a map of the survey track to Airservices Australia (Airservices), the providers of air traffic services (ATS) in that area.

The airspace around Avalon airport was designated as Class D[5] and ATS were being provided with the assistance of radar surveillance. Both aircraft had been identified on radar by the air traffic controller (controller) and had been given clearances. However, the clearance issued to JYG put the aircraft in conflict with PWQ.

At 1606, when the aircraft were 6 NM apart, the pilots of both aircraft acknowledged the following traffic information[6] provided by the controller:

> *PWQ there is a VFR aircraft Cessna about 2 miles west of Avalon doing a pipeline survey not above 1,500 tracking northbound.*
>
> *JYG did you copy PWQ it's a Seneca it's currently 4 miles north of Avalon at the moment inbound on the ILS at the minima will be overshooting to the west.*

A minute later, when the aircraft were 2 NM apart, the pilot of PWQ reported the other aircraft in sight but queried the controller on whether JYG would remain west of PWQ's track. With 0.8 NM separation, the controller provided PWQ with the following additional information:

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1 Instrument flight rules (IFR) permit an aircraft to operate in instrument meteorological conditions (IMC), which have much lower weather minimums than visual flight rules. Procedures and training are significantly more complex as a pilot must demonstrate competency in IMC conditions, while controlling the aircraft solely by reference to instruments. IFR-capable aircraft have greater equipment and maintenance requirements.

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

3 Instrument Landing System (ILS) – a standard ground aid to landing, comprising two directional radio transmitters: the localizer, which provides direction in the horizontal plane; and the glideslope, for vertical plane direction, usually at an inclination of 3°. Distance measuring equipment or marker beacons along the approach provide distance information.

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 Within Class D, IFR aircraft are not separated from VFR aircraft, but are provided with traffic information about VFR flights. VFR aircraft are not provided a separation service but are provided with traffic information about all other flights.

6 The Manual of Air Traffic Services (MATS) stated that traffic information must be concise and that reference information should be provided when traffic information related to positions or features not shown on enroute charts.

PWQ negative they're tracking northbound on a pipeline survey.

At 1607, the pilot of JYG reported sighting PWQ and, believing that a collision risk existed, transmitted he would '… climb to get out of the way.' The airprox[7] occurred at 1608 when the aircraft passed within 0.1 NM and 100 ft of each other.

Though both the pilot and observer on JYG were searching for PWQ, they had not seen it earlier as the other aircraft had been obscured by JYG's high wing.

Both aircraft were fitted with and were using strobe lighting. Neither aircraft was fitted with an Airborne Collision Avoidance System (ACAS)[8] nor was such fitment required.

The incident occurred during a handover between two controllers. Just prior to the airprox occurring, the controller handing over recognised the potential conflict. That controller made all radio transmissions until the handover was complete, about 30 seconds after the airprox.

Pilot comments

The pilot of PWQ reported that, as his aircraft was established on the ILS and he had been cleared for the approach, he believed he would not be expected to manoeuvre to avoid traffic. As it was a precision approach, any change to altitude or track to avoid traffic would have resulted in PWQ no longer being established on the ILS and necessitating a missed approach. The pilot noted the high workload involved when conducting instructional IFR training and that the incident may have been more serious if PWQ had been in instrument meteorological conditions (IMC)[9] until 800 ft.

Further, the pilot of PWQ stated that the traffic information provided was not sufficient for him to understand the intended track of the VFR aircraft. Of particular concern to him was the controller's response when he queried whether the traffic would remain west of the centreline. The pilot of PWQ did not know the location of the pipeline and it was not marked on any aeronautical chart. Additionally, the intended track of the VFR aircraft was north-easterly, not northerly as advised twice by the controller.

The pilot of JYG had extensive experience in Class D airspace, both in the Avalon area and at other locations around Australia[10]. The pilot of JYG reported that he had expected to be given tracking advice to remain clear if his aircraft was going to conflict with an IFR aircraft, as this had occurred on previous occasions in Class D airspace.

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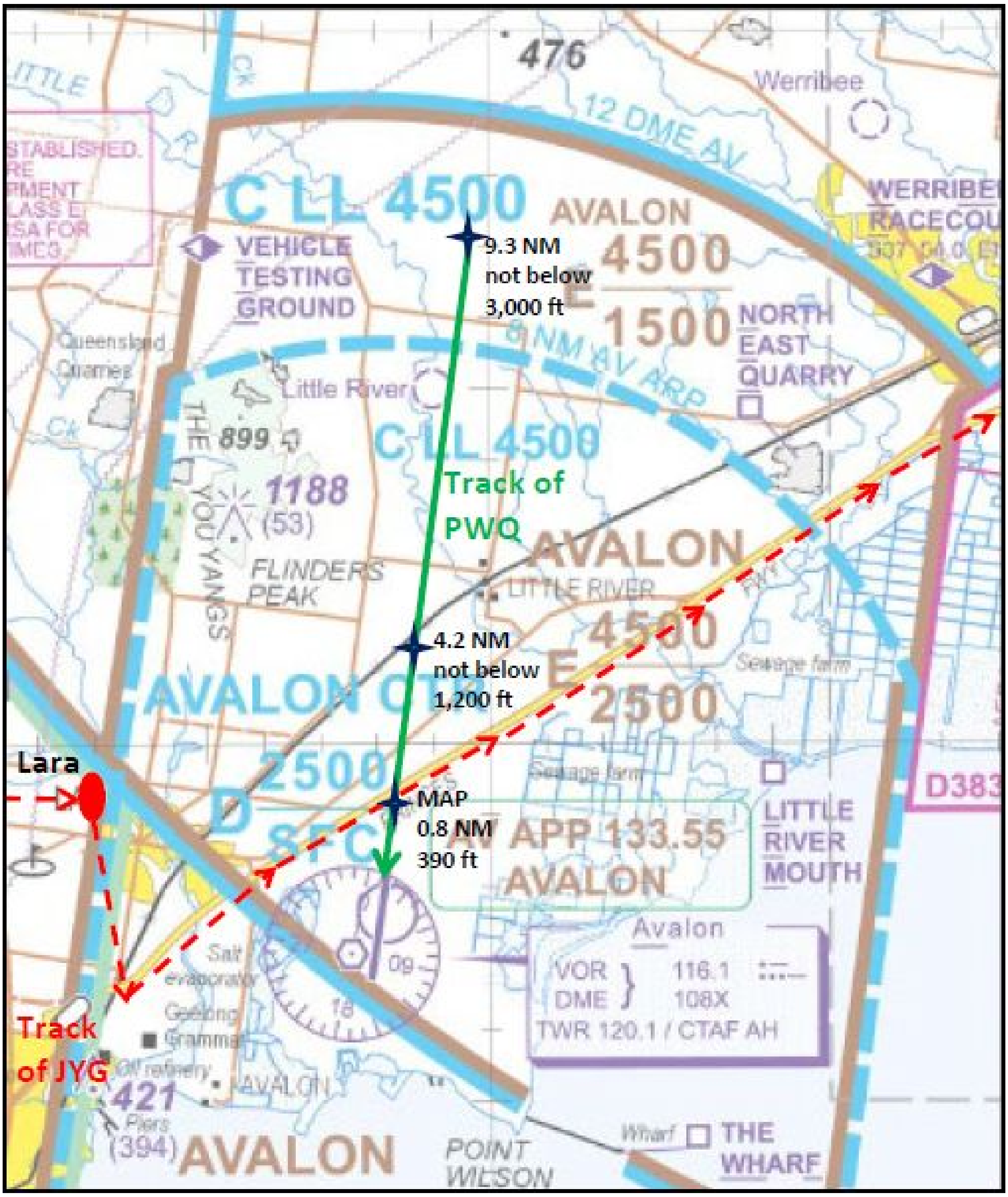
7 Airprox – an occurrence in which two or more aircraft come into such close proximity that a threat to the safety of the aircraft exists, or may exist, in airspace where separation is a pilot responsibility.

8 An Airborne Collision Avoidance System (ACAS) is an aircraft system that warns of the presence of other aircraft that present a threat of collision.

9 Instrument meteorological conditions (IMC) describes weather conditions that require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR), rather than by outside visual references. Typically, this means flying in cloud or limited visibility.

10 Class D airspace is established at 12 aerodromes around Australia.

Figure 8: Track of JYG (broken red) and PWQ (solid green) with ILS distances and heights (black text)



Source: ***Airservices Australia***

Safety alerts and traffic avoidance advice

Safety alerts[11], according to Manual of Air Traffic Services (MATS), should be issued when a controller becomes aware that an aircraft is in a situation that is considered to place it in unsafe proximity to terrain, obstructions, active restricted areas or other aircraft. In the absence of a safety alert, traffic avoidance advice should be provided when an aircraft in receipt of traffic information on another aircraft continues on a conflicting path and constitutes a collision hazard.

[11] Safety alert is the provision of advice to an aircraft when an ATS Officer becomes aware that an aircraft is in a position which is considered to place it in unsafe proximity to terrain, obstructions or another aircraft.

An amendment to MATS, effective on 28 June 2012, noted that a review of safety alerting and avoiding action had identified a disconnect between the importance of the information being assessed and passed and how the information was presented in the document. Changes in the amendment were the result of a review of relevant documentation from the International Civil Aviation Organization (ICAO) and the United Kingdom and were complementary to changes proposed in the Aeronautical Information Publication (AIP)[12].

The amended version of MATS included the following:

> *In surveillance coverage, issue avoiding action advice when you become aware that an aircraft is in a situation that is considered to place it at risk of a collision with another aircraft.*
>
> *You may issue Safety Alerts in all classes of airspace both within and outside ATS surveillance system coverage.*

Pilot responsibilities within Class D

When operating in Class D airspace, pilots must advise the controller if they are unable to see, or if they lose sight of, other aircraft notified as traffic and must maintain their own separation from that traffic.

ATSB comment

Both PWQ and JYG had been identified by the controller and neither changed course on receipt of the traffic advice. PWQ only reported sighting the other aircraft 30 seconds before their closest point of passing and JYG reported sighting 10 seconds prior to that point.

Safety message

Air traffic control

Traffic information must be concise, but it needs to include enough relevant reference information to enable the pilot to determine if action is required to avoid conflict. The recent amendments to MATS provided more detail on the provision of safety alerts in all classes of airspace and on when to issue avoiding action within surveillance coverage.

Pilots

In Class D, where separation is not provided between IFR and VFR aircraft, pilots need to be aware of the limitations of the see-and-avoid principle.

Pilots should be conscious of the dangers of expectation as this can limit both information processing and decision-making. The Civil Aviation Advisory Publication (CAAP) 5.59-1(0) titled *Teaching and Assessing Single-Pilot Human Factors and Treat and Error Management* is a useful document for a review of human factors.

Limitations of the See-and-Avoid Principle (1991) is available at:
www.atsb.gov.au/publications/1991/limit_see_avoid.aspx

CAAP 5.59-1(0) is available at:
www.casa.gov.au/wcmswr/_assets/main/download/caaps/ops/5_59_1.pdf

Further information on Class D airspace, including the Class D airspace booklet and eLearning tutorials, is available from CASA at:
www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD:611458872:pc=PC_93379

[12] The AIP is a package of documents that provide the operational information necessary for the safe and efficient conduct of national (civil) and international air navigation throughout Australia and its Territories.

Aircraft details

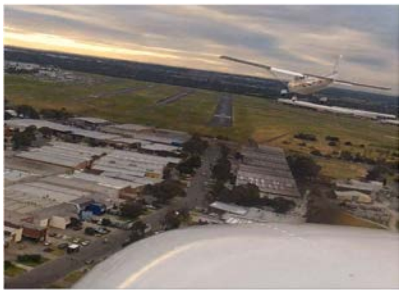
Manufacturer and model:	VH-PWQ: Piper Aircraft Corporation PA-34-220T VH-JYG: Cessna Aircraft Company R182	
Registration:	VH-PWQ VH-JYG	
Type of operation:	VH-PWQ: Flying training VH-JYG: Aerial work	
Location:	Avalon airport, Victoria	
Occurrence type:	Airprox	
Persons on board:	VH-PWQ: Crew – 2 VH-JYG: Crew – 2	Passengers – 1 Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	None	

Aircraft proximity event – two Cessna 172S, VH-EWE and VH-EOP

AO-2012-099

What happened

The incident



Source: *Pilot of VH-EOP*

On 19 July 2012, at about 1622 Eastern Standard Time[1], the pilot of a Cessna 172S aircraft, registered VH-EOP (EOP), broadcast on the Moorabbin Airport, Victoria, Tower frequency advising he was inbound from the 'Academy' visual flight rules approach point, following a Cessna 182T aircraft, registered VH-NEG (NEG). The pilot of EOP was instructed by Moorabbin air traffic control (ATC) to join the downwind leg of the circuit for runway 35 Right (R)[2]. At the same time, the flight instructor and student pilot of another Cessna 172S aircraft, registered VH-EWE (EWE), were on downwind, conducting circuit training.

Moorabbin is a general aviation airport, which operates under Class D[3] control zone procedures. In Class D airspace, ATC provides visual flight rules (VFR) aircraft with traffic information on other VFR aircraft. However, it is ultimately the pilot's responsibility to sight and maintain separation.

At about 1625, EOP joined downwind following NEG. Soon after, the instructor and student of EWE conducted a touch-and-go[4] and commenced another circuit.

When on downwind, the pilot of EOP noted that NEG was conducting a wider than normal circuit pattern to ensure separation with preceding aircraft. As a result, the pilot of EOP extended the downwind leg and commenced a wider base leg to maintain separation with NEG.

At about 1627, EWE was turned onto downwind, during which time the student made a broadcast on the Moorabbin Tower frequency advising they were turning downwind for a touch-and-go. Moorabbin ATC then instructed EWE to '...follow the Cessna turning, correction, on mid-base' (EOP). Both the instructor and student sighted a Cessna (NEG) in their 2 o'clock[5] position on late base, and believed this to be the aircraft referred to by ATC (Figure 1). Given the distance between EWE and NEG, the instructor of EWE believed there was sufficient separation between the two aircraft. The pilot of EOP reported hearing EWE broadcast their downwind call.

At about 1628, the instructor and student of EWE visually looked for traffic within the vicinity, and with no aircraft sighted, a closer than normal base leg was commenced. When on base, they observed NEG about to land on runway 35R. At about the same time, EOP turned onto final.

A subsequent review of Airservices Australia surveillance data showed that, at about 1629, EOP and EWE were on converging tracks (Figure 2). Shortly after, the instructor and student of EWE again looked for traffic. With no traffic sighted, they commenced the turn onto final. The turn was conducted lower and later than normal. At about the same time, EOP received an ATC clearance to land.

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

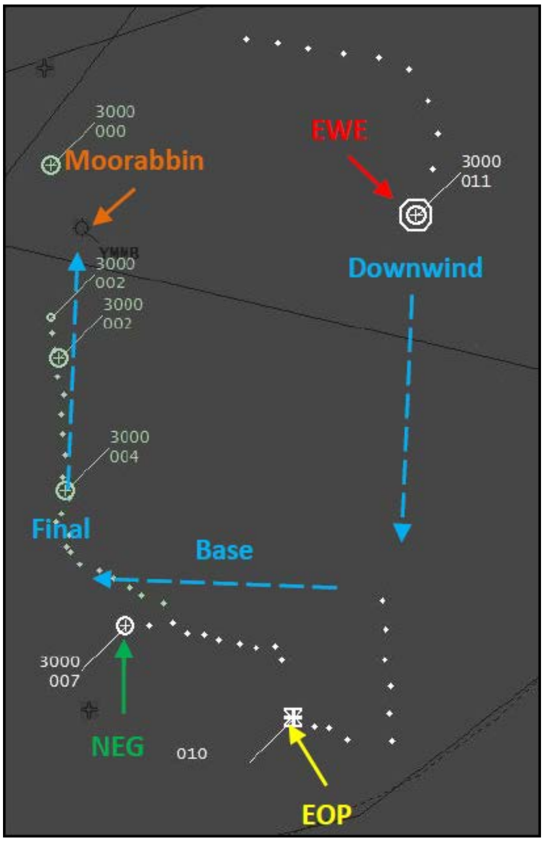
2 Circuits on runway 35R were right hand in direction.

3 Class D: all aircraft must obtain an airways clearance and communicate with ATC. Instrument flight rules (IFR) aircraft are positively separated from other IFR aircraft and are provided with traffic information on all VFR aircraft. VFR aircraft are provided with traffic information on all other aircraft.

4 A touch-and-go is a practice landing whereby the aircraft is permitted to touch the runway briefly before taking off again.

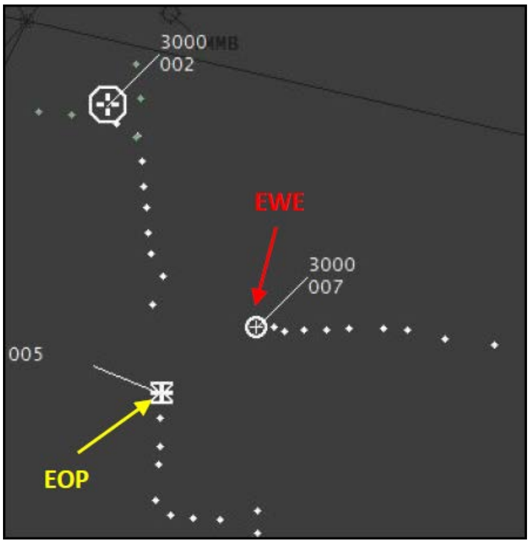
5 The clock code is used to denote the direction of an aircraft or surface feature relative to the current heading of the observer's aircraft, expressed in terms of position on an analogue clock face. Twelve o'clock is ahead while an aircraft observed abeam to the left would be said to be at 9 o'clock.

Figure 9: Aircraft positions at 1627



Source: *Airservices Australia*

Figure 10: Aircraft positions at 1629



Source: *Airservices Australia*

The pilot of EOP reported that several seconds later he observed EWE pass overhead from his right, about 10-20 metres in front of his aircraft (Figure 3). In response, he reduced engine power and raised the nose of the aircraft slightly to slow the aircraft and increase separation. The pilot then advised ATC that EWE had ‘cut in front’ of his aircraft. Air traffic control immediately instructed EWE to conduct a go-around. The student of EWE commenced a go-around and EOP landed without further incident.

The instructor of EWE reported that he was not aware of EOP operating in the circuit until after the incident occurred.

Figure 11: The incident

Source: *Pilot of VH-EOP (from a dash mounted video camera)*

Joining the circuit

The pilot of EOP stated that he did not make a broadcast when joining downwind as he was of the understanding that such a call was not required when inbound, unless instructed to do so by ATC. The Civil Aviation Safety Authority's (CASA) visual pilot guide (VPG) 2010 for the Melbourne basin, incorporating Moorabbin Airport, stated that 'unless otherwise instructed by ATC, you must report downwind when starting or joining the downwind leg'.

Instructor comments (VH-EWE)

The instructor of EWE reported that the following factors may have contributed to the incident:

- **Radio broadcasts:** The instructor stated that he could not recall hearing any broadcasts made relating to EOP. The student had recently commenced circuit training and the instructor had spent a reasonable amount of time throughout the lesson conversing and demonstrating. It was possible that any broadcasts made could have been missed. As a result of this incident, the instructor now limits his conversation. If a detailed explanation is required, he assumes control of the aircraft and demonstates, rather than talking the student through the procedure.
- **Traffic scanning area:** The instructor reported that EOP may have been outside his normal scan area when looking for traffic due to the wide circuit pattern conducted by EOP.
- **Lookout vigilance:** The instructor was of the understanding that they were following NEG in the circuit. Consequently, when he observed NEG landing, he reported that his lookout vigilance may have reduced as he believed there was no other traffic to follow.
- **Wind:** The distance between EWE and EOP reduced as a result of a tailwind on downwind and a headwind on base and final.

When EWE received an ATC sequencing instruction[6] to follow a Cessna on mid-base, both NEG and EOP were on the base leg. The instructor commented that the issue of a sequence number[7] by ATC may have enhanced his situation awareness, particularly in the later stages of the circuit when NEG was observed landing.

Safety message

The practice of see-and-avoid has long been recognised as the primary method for minimising the risk of collision when flying in visual meteorological conditions; it is considered a crucial element of a pilot's situation awareness. An ATSB research report titled '*Limitations of the See-and-Avoid Principle*' showed that, when searching for traffic, alerted see-and-avoid (when a radio is used in combination with a visual lookout) is eight times more effective than unalerted see-and-avoid (when no radio is used). However, pilots should be mindful that the absence of a traffic broadcast does not necessarily mean the absence of traffic. Pilots should remain vigilant and employ both unalerted and alerted see-and-avoid principles to ensure the greatest level of traffic awareness is achieved.

Further information on the limitations of the see-and-avoid principle is available at:

- www.atsb.gov.au/publications/1991/limit_see_avoid.aspx

Aircraft details

Manufacturer and model:	VH-EWE:	Cessna Aircraft Company 172S	
	VH-EOP:	Cessna Aircraft Company 172S	
Type of operation:	VH-EWE:	Flying training	
	VH-EOP:	Private	
Location:	Moorabbin Airport, Victoria		
Occurrence type:	Aircraft separation		
Persons on board:	VH-EWE:	Crew – 2	Passengers – Nil
	VH-EOP:	Crew – 1	Passengers – 1
Injuries:	Crew – Nil	Passengers – Nil	
Damage:	Nil		

6 Aeronautical Information Package (AIP) ENR 1.1-30 paragraph 15.1.2 states that 'In sequencing aircraft ATC will indicate the position of the preceding aircraft by reference to a leg of the circuit or as a clock bearing, and describe it either as a specific type or in general terms.' ATC may also issue a sequence number.

7 Sequence numbers specify the landing sequence position of an aircraft with respect to any preceding aircraft.

Hard landing – Cessna 172S, VH-EOP

AO-2012-114

Aircraft damage

Source: ***Aircraft operator***

What happened

On 2 September 2012, the pilot of a Cessna 172S aircraft, registered VH-EOP, was returning to Moorabbin Airport, Victoria, after having conducted a navigation training flight.

When on the final leg of the circuit, the pilot conducted his pre-landing checks and prepared the aircraft for landing. He reported that the approach was normal.

During the landing, at about 50-60 ft above the runway, the flare[1] was commenced. The pilot then attempted to initiate the hold-off by applying rearward pressure on the control column. However, the pilot reported that the control column would not move and was 'stuck'. An excessive rate of sink occurred, resulting in a hard landing on the nose and main landing gear, and the propeller. The pilot reported that, after bouncing twice, he applied left rudder and the aircraft veered off the runway, coming to rest on a grassed area. The pilot notified Moorabbin air traffic control of the situation, shutdown the aircraft, and exited. The aircraft sustained substantial damage as a result of the hard landing.

Soon after, the aircraft operator visually inspected the aircraft in-situ and noted that both the elevator and aileron controls would not move.

Aircraft examination

Both the pilot and aircraft operator reported that there were no pre-existing issues with the aircraft's control system prior to the accident.

A detailed examination determined that, as a result of the hard landing, the aircraft sustained damage to the propeller and engine firewall. The centre pedestal had been raised by about 1.3 cm, which had jammed the elevator control and distorted the aileron control (Figure 1). The examination was unable to determine why the control column did not move during the hold-off, as reported by the pilot.

Figure 12: Aircraft damage

Source: *Aircraft operator*

[1] The flare, also known as the roundout, is the final nose-up of a landing aircraft to reduce the rate of descent to about zero at touchdown.

Aircraft details

Manufacturer and model:	Cessna Aircraft Company 172S	
Registration:	VH-EOP	
Type of operation:	Flying training	
Location:	Moorabbin Airport, Victoria	
Occurrence type:	Aircraft control	
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Helicopters

Collision with terrain – Robinson R22, VH-STK

AO-2012-091

What happened

Accident site

Source: The aircraft operator

At 0840 Eastern Standard Time[1] on 6 July 2012, during mustering operations near Miranda Downs aeroplane landing area (ALA), Queensland, the right skid of a Robinson R22 Beta (R22) helicopter, registered VH-STK (STK), struck a tree, causing the aircraft to collide with terrain (Figure 1). The pilot, the only occupant, was seriously injured and the helicopter sustained substantial damage.

STK had departed Miranda Downs ALA at 0640 with another helicopter. Together the helicopters had mustered cattle in a paddock about 30 km from the ALA. STK then departed the area to check on a dam that would be used as a target point in the next mustering activity.

When unable to contact the pilot of STK on the radio, the pilot of the other helicopter conducted a brief search and found the accident site. The pilot of STK had no memory of the accident sequence.

The operator conducted an investigation into the accident and, using Global Positioning System (GPS) data, determined that STK had been operating at an average altitude of about 310 ft above ground level (AGL). Tracking for the dam, STK climbed to 2,308 ft AGL with a ground speed of 24 kt before commencing a spiral descent to the left to an altitude of 283 ft AGL at a ground speed of 42 kt. The last recorded data was an altitude of about 83 ft AGL and ground speed of 57 kt.

Bureau of Meteorology data indicated that the temperature was 14.7° C and the dew point 1.3° C. The operator determined that the combination of temperature and dew point would indicate a moderate carburettor icing[2] risk at cruise power and a serious icing risk at descent power.

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

[2] Carburettor ice is formed when the normal process of vaporising fuel in a carburettor cools the carburettor throat so much that ice forms from the moisture in the airflow and interferes with the operation of the engine.

Figure 13: Accident site

Source: The aircraft operator

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 actions in response to this occurrence.

Aircraft operator

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

Carburettor icing

The aircraft operator reminded all pilots of the content of the Robinson Safety Notice SN-25 – *Carburettor Ice*, and to be familiar with Section 4 of the R22 Flight Manual – *Normal Procedures*, particularly page 4-11 – *Use of carburettor heat* and *Use of carb heat assist*.

Auto-rotations

The aircraft operator also advised their pilots to be aware of the details in Robinson Safety Notice SN-38 – *Practice Autorotations Cause Many Training Accidents*, and also cautioned them that auto-rotations should only be practised or used for rapid decent when the pilot is confident that they are over an area where a safe power-off landing can be made in case of engine stoppage.

Safety message

Carburettor ice can occur in temperatures as high as 32° C with high humidity. Pilots are reminded to maintain awareness of the weather conditions that are conducive to carburettor ice formation and closely monitor aircraft performance during times when the risk exists.

The following publications provide useful information on carburettor icing and avoidance:

- Robinson Safety Notice SN-25 – *Carburettor Ice*
  www.robinsonheli.com/srvclib/rchsn25.pdf
- Robinson Safety Notice SN-31 – *Governor Can Mask Carb Ice*
  www.robinsonheli.com/srvclib/rchsn31.pdf
- *Ice Advice,* in Flight Safety Australia, March-April 2006, pages 26-33
  www.casa.gov.au/fsa/2006/apr/26-33.pdf
- *Ice Blocked*, in Flight Safety Australia, November-December 2004, pages 31-33
  www.casa.gov.au/fsa/2004/dec/32-33.pdf
- The ATSB educational fact sheet titled *Melting Moments: Understanding Carburettor Icing* is available at:
  www.atsb.gov.au/publications/2009/carburettor-icing.aspx
- The Civil Avaition Safety Authority (CASA) Carburettor icing probability chart can be purchased from the CASA Shop and is available at:
  www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD:1543755187:pc=PC_90006

The Robinson Safety Notice SN-38 – *Practice Autorotations Cause Many Training Accidents is available at:*
www.robinsonheli.com/srvclib/rhcsn-38.pdf

The following ATSB investigation reports provide further reading on carburettor icing:

- ATSB Report AO-2010-107
  www.atsb.gov.au/publications/investigation_reports/2010/aair/ao-2010-107.aspx
- ATSB Report AO-2009-031
  www.atsb.gov.au/publications/investigation_reports/2009/aair/ao-2009-031.aspx

Helicopter details

Manufacturer and model:	Robinson Helicopter Company R22 Beta	
Registration:	VH-STK	
Type of operation:	Aerial mustering	
Location:	23 km north east of Miranda Downs ALA, Queensland	
Occurrence type:	Collision with terrain	
Persons on board:	Crew – 1	Passengers – nil
Injuries:	Crew – 1 serious	Passengers – nil
Damage:	Substantial	

Other vehicles

Runway incursion – Perth airport safety vehicle

AO-2012-086

Perth airport

Source: Airservices Australia

What happened

From 0252 Western Standard Time[1] on 15 June 2012, Perth Airport, Western Australia, was operating on runway 21 under low visibility procedures, due to fog. Under these procedures, an airport operations officer (AOO) measured the runway visibility using published techniques and provided the information to air traffic control (ATC)[2].

To calculate the visibility, the AOO was required to drive along the runway that was in use, from the threshold of runway 21 (Figure 1) to a documented intermediate observation point (position 4[3] for runway 21). The AOO then reported the number of runway edge lights observed from each location. When not measuring the runway visibility, the AOO was required to park the vehicle at a designated position (position 9) away from the runway monitor the Perth Tower (Tower) radio frequency on 120.5 MHz.

At 0545 the AOO, using the callsign Safety 2, entered runway 21 and conducted a runway visibility check before returning to position 9 on the airfield. At about 0550, a handover was conducted between AOOs at position 9. The taking-over AOO had contacted Perth Ground (Ground) on 121.7 MHz prior to first entering the airfield then switched the radio to the Tower frequency as part of the handover.

At about 0555, the air traffic controller (Tower) instructed a Piper PA-42 aircraft, registered VH-BUW (BUW), to line up on runway 21. The controller, using non-standard phraseology (Table 1), then instructed Safety 2 to provide a count of runway edge lights. At 0557, during the exchange between Tower and Safety 2, Safety 2 entered runway 21 without a clearance at taxiway J. When instructed by Tower, Safety 2 immediately vacated runway 21 via taxiway J.

Low visibility procedures ceased at 0605 when the visibility improved to greater than 10 km in fog patches.

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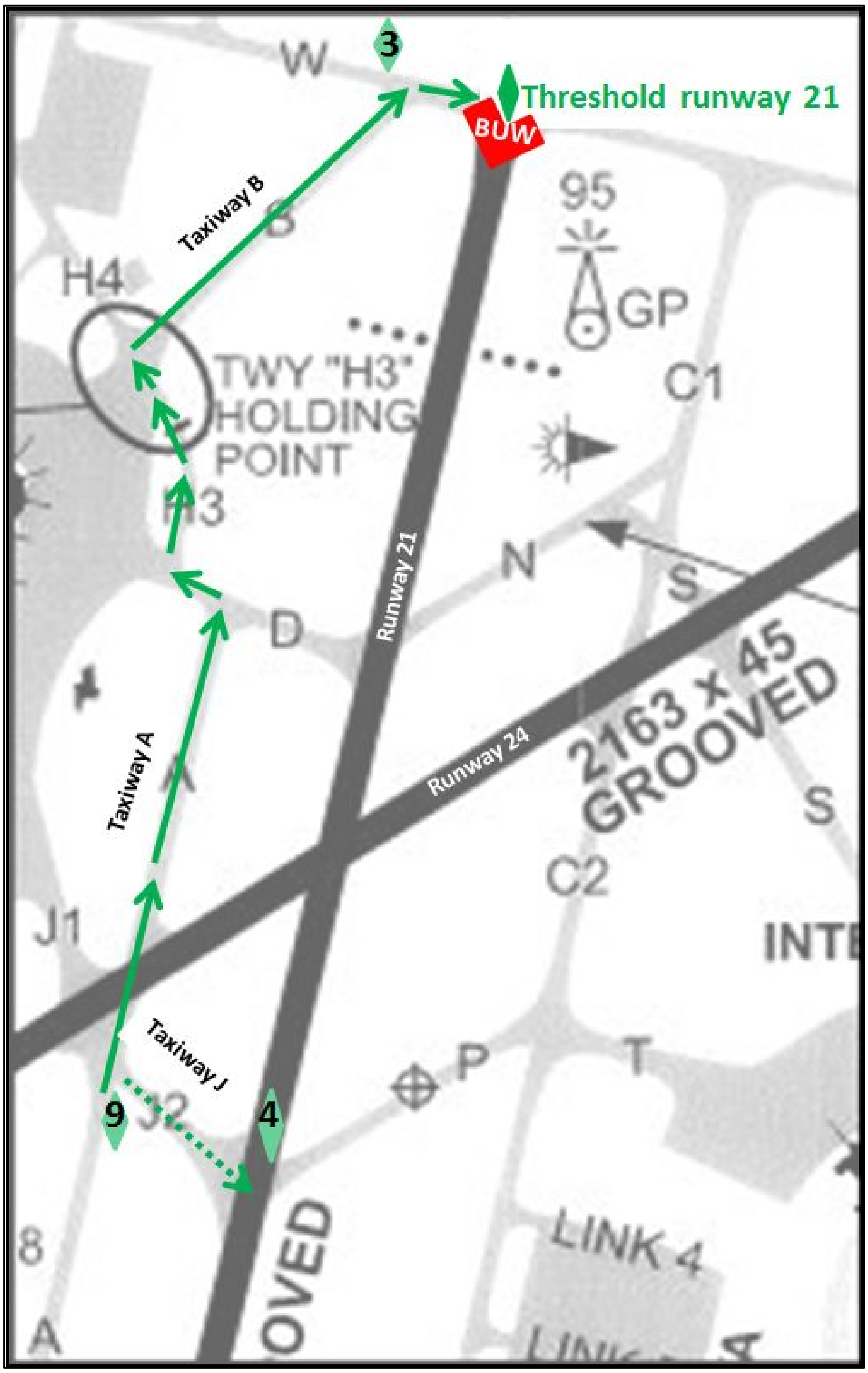
1 Western Standard Time (WST) was Coordinated Universal Time (UTC) + 8 hours.

2 ATC at Perth Airport is provided by Airservices Australia.

3 The positions are designated in the Perth Airport Runway Visual Range Assessment Chart

Figure 14: Location of safety vehicle positions (green diamonds), actual path of Safety 2 (dotted green line), path of Safety 2 as intended by ATC (solid green line) and location of BUW at the threshold of runway 21 (red)



Source: Airservices Australia

Table 1: Relevant radio transmissions from 0555 to 0558

Agency	Text of transmission	Notes
Tower	Safety 2 can you go to the threshold again and give us a count?	1
Safety 2	Enter runway 21 cross runway 24, Safety 2.	2
Tower	Is that Safety 2, I can barely hear you?	
Safety 2	Radio check please.	
Tower	Safety 2 read you 5.	3
Safety 2	...cross runway 24...	4
Tower	Safety 2 cross runway 24 and proceed to the threshold runway 21.	1
Safety 2	(unintelligible) ... runway 21, cross runway 24 Safety 2.	
Tower	Bravo Uniform Whiskey I didn't want you to enter runway 21. I wanted you to cross runway 24 and proceed up Alpha to the threshold.	1 and 5
Tower	Safety 2 I didn't want you to enter runway 21. I wanted you to proceed up Alpha to the threshold runway 21.	1
Safety 2	Confirm that was for Safety 2 and not Bravo Uniform Whiskey?	
Tower	Safety 2 affirm, vacate runway 21, and proceed up Alpha, cross runway 24 to the threshold runway 21.	1
Safety 2	Vacate runway 21, proceed up Alpha to, ah, just confirm the threshold of runway 03?	1
Tower	Negative, threshold runway 21.	1
Safety 2	Proceed up Alpha, cross runway 24 and proceed to the threshold of runway 21, Safety 2.	1

Notes:

1. Non-standard phraseology.
2. Safety 2 responded to the non-standard phraseology with what he thought the Tower controller meant.
3. '… read you 5' meant that the radio transmission was perfectly readable.
4. Safety 2's response was over-transmitted by a radio call from an aircraft.
5. The Tower controller inadvertently used BUW's callsign instead of Safety 2

Airport operations officer comments

In response to the non-standard phraseology, the AOO had read back what he believed the controller wanted him to do, expecting the Tower to respond with a correction or a confirmation (see Note 2 in Table 1). Although he was not cleared to enter runway 21, the AOO noted that to '… go to the threshold …' would require Safety 2 entering the runway. In the two and a half years the AOO had been employed by the Perth Airport Pty Ltd (Perth Airport) to conduct these duties, he had not been required to track via the taxiways for a runway visibility check.

Further, as Safety 2 was on the Tower frequency, the AOO would not have been aware of aircraft or vehicle movements on the taxiways as they would be operating on the Ground frequency. The AOO also noted that when he arrived at position 9 for the handover, the visibility was such that he could see both ends of runway 21, although low visibility procedures were still in operation.

Tower controller comments

The Tower controller did not know that there had been a handover between AOOs and thought that Safety 2 was the same person as had been operating earlier. The controller noted that the visibility at the time of the runway incursion was good and he observed Safety 2 entering runway 21.

The controller had asked Safety 2 to provide the runway visibility measurement so that the low visibility procedures could be formally ended.

ATSB Comment

The Aeronautical Information Publication (AIP)[4] stated:

> *Use of standard phrases for radio telephony communication … is essential to avoid misunderstanding the intent of messages and to reduce the time required for communication.*

An airside driver's guide to runway safety, published by Airservices Australia, also emphasised the need for standard phraseology. The use of non-standard phraseology by the Tower controller resulted in Safety 2 misunderstanding an instruction and entering the active runway.

Safety actions

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.

Perth Airport Pty Ltd

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

Perth Airport held workshops for all AOOs that reiterated the following:

- Identify what is an implied or unclear instruction from ATC;
- Ensure that the unclear instruction is positively clarified (corrected by ATC, not clarified in the read back);
- Reiterate that implied clearances are not a clearance to enter or cross a runway; and
- Reaffirm that the words "cross" or "enter" must be given and understood before entering or crossing a runway.

Perth Airport is also working with ATC in relation to non-standard phraseology.

Training for AOOs and other airside drivers will be enhanced with modules on human factors, AOO procedures for handovers on the airfield are being reviewed and Perth Airport is reviewing recent runway incursions to enable any trends identified to be addressed.

Airservices Australia

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

To further enhance airport safety, Airservices will issue a Standardisation Directive to remind controllers of the importance of using standard phraseology for interaction with ground vehicles.

Airservices will also review the industry communications document *Airside Driver's Guide to Runway Safety – Safe surface operations* at controlled aerodromes to ensure that the document continues to be accurate and relevant for the promotion of runway safety performance.

Safety message

This incident is a reminder that in safety critical situations all radio communications phraseology should be clear, concise and unambiguous. It is also a reminder to drivers operating on an airfield to seek clarification of ATC instructions should there be any doubt as to the content or intent of the instruction.

The following ATSB investigation report provides further reading on runway incursions:

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[4] A package of documents that provides the operational information necessary for the safe and efficient conduct of national (civil) and international air navigation throughout Australia and its Territories.

AO-2010-011 – Runway incursion - PK-GMG, Perth Aerodrome WA, 24 February 2010 is available at:
www.atsb.gov.au/publications/investigation_reports/2010/aair/ao-2010-011.aspx

An Airside driver's guide to runway safety (3rd edition – June 2012) is available at:
www.airservicesaustralia.com/wp-content/uploads/airside_drivers_guide.pdf

Airport safety vehicle details

Manufacturer and model:	Not applicable	
Operator:	Perth Airport Pty Ltd	
Registration:	Safety 2	
Type of operation:	Airport safety vehicle - low visibility operations	
Location:	Perth airport, Western Australia	
Occurrence type:	Runway incursion	
Persons on board:	Crew – 1	Passengers – nil
Injuries:	Crew – nil	Passengers – nil
Damage:	None	

Runway incursion – Mackay airport safety vehicle

AO-2012-090

What happened

On 29 June 2012, at about 1754 Eastern Standard Time[1], the Airport Safety Officer (ASO) at Mackay Airport, Queensland contacted Mackay Tower air traffic control (ATC) to request a clearance for Car Two to enter the airport runway environment for a routine runway pavement and lighting inspection. Car Two was a Toyota Hilux airport safety vehicle with appropriate and serviceable hazard lighting. Mackay Tower cleared Car Two to enter runway 14 and runway 05. Car Two entered runway 14 at taxiway Alpha, and proceeded in a south-easterly direction to initially inspect the runway 32 T-VASIS[2] installation. The ASO planned to inspect the T-VASIS installation, then position at the threshold of runway 32 before proceeding in a north- westerly direction along the runway to continue the runway pavement and lighting inspection (Figure 1).

At about this time, the pilot of a Piper PA-31 Navajo aircraft, registered VH-LWW (LWW), was preparing to depart Mackay on a charter flight to Emerald, Queensland. The pilot, who was the only person on board, contacted Mackay Ground for a taxi clearance from the western general aviation (GA) apron, and requested runway 05 for departure. Mackay Ground cleared LWW to taxi for runway 05 via taxiway Hotel.

The pilot of LWW contacted Mackay Tower when approaching runway 05 and was cleared to backtrack and line up on runway 05. Immediately following the pilot's read back, Mackay Tower instructed the ASO in Car Two to hold short of runway 05. The ASO, who was in the process of inspecting the runway 32 T-VASIS, understood and correctly read back the instruction. He later reported that he was aware that an aircraft was about to depart off runway 05.

As LWW backtracked on runway 05, the ASO completed his inspection of the runway 32 T-VASIS installation, and proceeded to the threshold of runway 32 to continue the runway pavement and lighting inspection. Between the time the ASO acknowledged the ATC instruction to hold short of runway 05 and positioning at the threshold of runway 32, the ASO received a mobile telephone call. The ASO accepted and continued with the call as he travelled to the threshold of runway 32 and commenced the runway 14/32 pavement and lighting inspection.

At around 1757, the pilot of LWW reported ready for takeoff on runway 05, and was cleared for takeoff several seconds later. By that time, the ASO had likely commenced his inspection of runway 14/32, moving in a north-westerly direction from the threshold of runway 32. Contrary to the ATC instruction to hold short of runway 05, the ASO continued through the runway intersection. LWW passed over Car Two at the runway intersection, at about 30 ft above ground level.

The ASO became aware of LWW as the aircraft passed overhead the vehicle. He immediately realised what had occurred, terminated the telephone call, and exited the runway toward the eastern GA apron on his right. The elapsed time between the ATC instruction to hold short of runway 05 to the runway incursion was about two minutes. The ASO had been on the telephone for about one minute when the incident occurred. In hindsight, the ASO believed that he was distracted by the telephone call, which allowed his situation awareness to be compromised.

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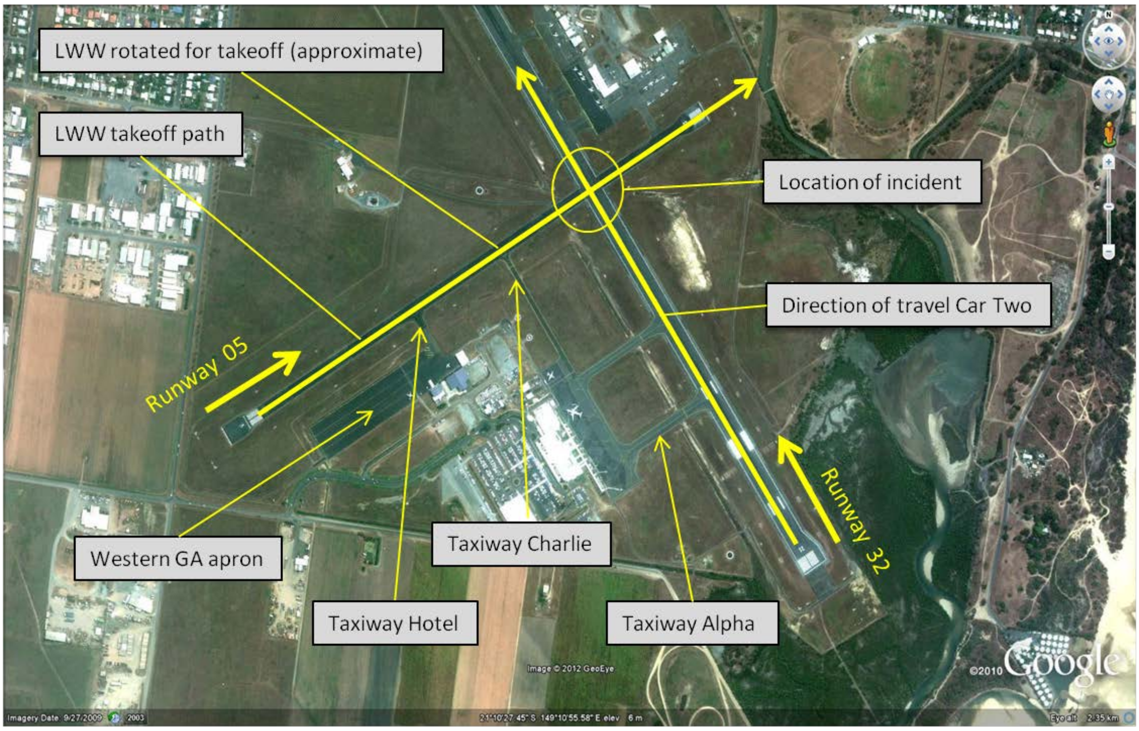
1 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) +10 hours.

2 T-VASIS is the Visual Approach Slope Indicator System installed in the flight strip of some runways to provide approach guidance to that runway. The T-VASIS installation spans a large area each side of the runway pavement, extending from a point just beyond the threshold of the runway to a point approximately 500 metres from the runway threshold.

The pilot of LWW first noticed Car Two on his right, as he passed about 60 kts during the takeoff run on runway 05. He initially thought that the vehicle was moving along an airport perimeter road, but soon realised that the vehicle was moving in a north-westerly direction along the intersecting runway. The pilot was immediately concerned that a collision would occur, given that Car Two was maintaining a constant relative position in his field of view. The pilot assessed that if he rejected the takeoff, he would not be able to stop in time to avoid a collision and elected to continue the takeoff. The pilot rotated the aircraft for takeoff approximately abeam the runway intersection with taxiway Charlie.

Figure 15: Mackay Airport



Source: ***Google Earth***

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.

Airport authority

As a result of this occurrence, the airport authority issued a safety bulletin to remind airside vehicle operators of the hazards associated with the use of a mobile telephone while driving. The Airside Driving Handbook issued by the airport authority stipulated that mobile telephones were not to be used while operating a mobile vehicle airside. To reinforce that stipulation, the safety bulletin required that drivers stop their vehicle in a safe place to make or receive a telephone call. The bulletin also required drivers under the control of ATC to advise ATC of their intentions and then vacate the manoeuvring area or runway environment before making or receiving a telephone call.

In addition to a number of short term follow-up actions, the airport authority has planned several wide-ranging actions to reduce the likelihood of similar occurrences. These actions include a review of the Safety Management System and Airside Vehicle Control Manual, a systemic review of the ASO role, and further development of the competency maintenance program for airport safety staff.

Safety message

In 2012, Airservices Australia published the third edition of *An Airside Driver's Guide to Runway Safety*. This publication identified a range of safety measures intended to help reduce the likelihood of runway incursions, including information about situation awareness and communications. This publication also highlighted the importance of scanning runways before entering or crossing a runway.

www.airservicesaustralia.com/wp-content/uploads/airside_drivers_guide.pdf

A Department of Infrastructure and Transport road safety grant report published in December 2010, titled *In-car distractions and their impact on driving activities*, recognised that distraction from a mobile telephone may divert a driver's mental and perceptual attention from the task of driving, and may increase response times to events.

www.infrastructure.gov.au/roads/safety/publications/2010/incar_distractions_att_10.aspx

This incident highlights the importance of remaining vigilant during airside operations, and to be mindful of the potential distraction presented by all portable communication devices, including mobile telephones.

Airport safety vehicle details

Manufacturer and model:	2008 Toyota Hilux Dual Cab	
Operator:	Mackay Airport Pty Ltd	
Registration:	Car Two	
Type of operation:	Airport safety vehicle – runway inspection	
Location:	Mackay Airport	
Occurrence type:	Runway incursion	
Persons on board:	Crew – 1	Passengers – nil
Injuries:	Crew – nil	Passengers – nil
Damage:	None	

Australian Transport Safety Bureau

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

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated. The terms the ATSB uses to refer to key safety and risk concepts are set out in the next section: Terminology Used in this Report.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this Bulletin

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

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

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

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

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

Conducting these Short investigations has a number of benefits:

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

ATSB Transport Safety Report

Aviation Short Investigation Bulletin Issue 13
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Final