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What happened

On 7 June 2016 at about 1000 Western Standard Time (WST), a Fokker F28 MK 0100 aircraft, registered VH-NHF, departed on a charter flight from Christmas Creek to Perth, Western Australia. On board were five crewmembers and 28 passengers.

The aircraft was on climb to the planned cruise altitude of FL 340[1] and the weather was generally clear and smooth with intermittent icing conditions. The first officer was the pilot flying (PF) and the captain was the pilot monitoring (PM) for this flight.[2]

As the aircraft climbed through FL 200, the flight crew heard a ‘whistling’ noise. They did not notice any other abnormal indications and after about one minute, the noise stopped. At about FL 305, a loud ‘whooshing’ noise was heard by the flight crew on the flight deck and the three cabin crewmembers who were standing in the forward galley.

The cabin crew believed the noise was coming from the forward lavatory, so one cabin crewmember inspected the lavatory, but could not identify where the noise was coming from. The PM checked the aircraft pressurisation indications located on the cockpit overhead panel and noticed that the cabin altitude[3] indicated 6,000 ft as expected, but the cabin pressure rate of climb had increased from about 200–300 ft/min to about 500 ft/min[4] (Figure 1). This indicated to the PM that they were losing cabin air faster than the pressurisation system could pressurise the aircraft.

Figure 1: F28 cabin pressure gauges

Source: Operator annotated by ATSB

The PM contacted air traffic control (ATC) to request a level-off at FL 320, rather than their planned level of FL 340. At about this time, the cabin manager informed the flight crew that the cabin crew had heard a ‘suction’ noise from the forward lavatory, but could not identify the source of the noise. The PM asked the cabin manager to cautiously inspect the forward lavatory again.

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1 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 340 equates to 34,000 ft.

2 Pilot flying (PF) and pilot monitoring (PM) are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF’s actions and aircraft flight path.

3 Altitude corresponding to pressure inside the cabin. 6,000 ft cabin altitude corresponds to an atmospheric pressure of 6,000 ft (See *F28 pressurisation – general description* below).

4 Engine compressor bleed air is used to supply pressurised air through ducting to the two air-conditioning packs. The air-conditioning packs then deliver air at a flow rate, pressure and temperature that maintains suitable conditions in the aircraft. The pressurisation system normally operates in automatic mode, but has a manual back-up mode if required.

The flight crew then received a 'PACK 1'[5] level 2 warning[6] in the cockpit and the associated emergency procedure displayed on the multi-function display unit (MFDU). The first step of the procedure was to turn off the affected air-conditioning pack and wait two minutes for the pack to cool before attempting a reset. When the PM turned off air-conditioning pack 1, they noticed the cabin pressurisation rate of climb increase to in excess of 2,000 ft/min.

The PM contacted ATC again and requested a descent to FL 250 and received a clearance from ATC to initially descend to FL 290 due to an airspace boundary. Before the PF was able to start the descent, the flight crew received an 'auto-throttle 1'[7] level 1 warning. At about this time, the PM informed the cabin manger that they were about to activate the seat-belt sign because an 'excessive cabin altitude' warning was imminent and the emergency oxygen would deploy.

Before the two minutes passed for the air-conditioning pack reset, the 'excessive cabin altitude'[8] level 3 warning activated. The flight crew performed their initial drill,[9] which included donning their oxygen masks. The PM then checked the cabin altitude, noticed it was indicating in excess of 25,000 ft and that the passenger emergency oxygen had deployed, and made a PAN[10] call to ATC. They received a clearance for an immediate descent to 10,000 ft, and the PF initiated an emergency descent.

As the aircraft descended, the cabin crew performed their 'sit-fit-advise'[11] drills for deployment of passenger emergency oxygen and the flight crew performed their 'emergency descent procedure'. The flight crew completed their 'excessive cabin altitude' procedure during the descent and then discussed their requirements for flight at 10,000 ft, which included alternate destination options. The PF levelled the aircraft at 10,000 ft and the flight crew completed the 'emergency descent procedure', which included a public address that emergency oxygen was no longer required.

The flight crew completed the air-conditioning pack and auto-throttle emergency procedures. After air-conditioning pack 1 was selected on, the cabin altitude decreased to 1,500 ft and the PACK 1 fault did not return for the rest of the flight. The PM left the seat belt light on for the remainder of the flight, but gave permission for the cabin crew to leave their seats to check on the needs of the passengers.

The cabin crew checked on the condition of the passengers and noted that one passenger wished to continue using supplemental oxygen. The cabin crew facilitated the passenger's request and provided them with portable oxygen for the remainder of the flight.

ATC contacted the aircraft for a progress update and provided the latest weather details for Newman, Meekatharra and Perth. The flight crew diverted the aircraft to Newman Airport, which was the closest option with company ground services. The crew advised ATC that an ambulance was required on arrival.

The aircraft landed at Newman at about 1100. Paramedics were available on arrival at Newman to provide assistance, but were not required.

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5 This warning refers to the number 1 air-conditioning pack.

6 There are three levels of warning; 1, 2 and 3, level 3 being the highest level of warning. When a higher level of warning is activated the associated procedure is prioritised on the MFDU, replacing any active lower level warning procedures.

7 Auto-throttle is linked to the automatic flight control system so that engine thrust is varied automatically according to the flight profile of the aircraft.

8 The excessive cabin altitude warning activates at about 10,000 ft cabin altitude, and the passenger emergency oxygen automatically deploys at about 14,000 ft cabin altitude. The deployment of passenger emergency oxygen is indicated in the cockpit and the pilots must manually deploy the system if it fails to deploy automatically. This check is included in the 'excessive cabin altitude' procedure.

9 Immediate actions performed from memory before reference to the checklist.

10 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.

11 Sit down, fit oxygen masks and advise passengers.

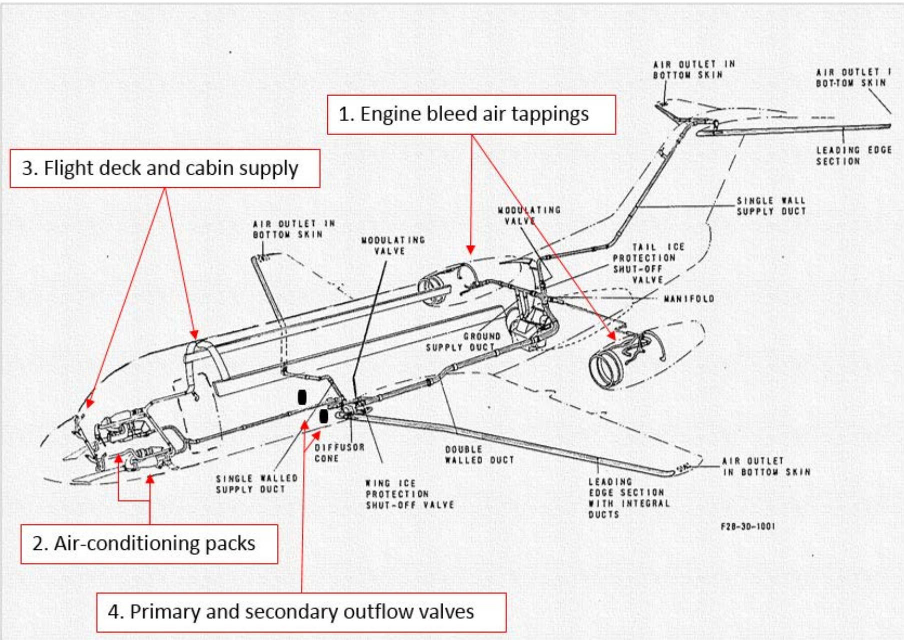
F28 pressurisation – general description

Bleed air is compressed air taken from the compressor stage of the engine. Bleed air is used for several functions including pressurisation, air-conditioning and anti-icing. For pressurisation, the bleed air is supplied to the two air-conditioning packs located underneath the floor of the flight deck, which are used to control the temperature of the air prior to distribution into the flight deck and cabin (Figure 2).

Cabin pressure is regulated by the outflow valves, which control the outflow of air from the cabin in either automatic or manual mode. Controls for automatic and manual mode of operation are located on the flight deck. In automatic operation, the differential pressure[12] of 7.46 psi provides a cabin pressure altitude of 8,000 ft at an aircraft altitude of 35,000 ft (FL 350). The outflow valves will normally limit the maximum pressure differential in automatic and manual mode to 7.65 psi and the cabin pressure altitude to 12,000 ft plus or minus 1,500 ft, provided airflow from the air-conditioning pack(s) is available. An excessive cabin altitude warning is presented at 10,000 ft. The cabin is automatically depressurised upon landing and there are two negative pressure relief valves to prevent negative cabin pressure.

When one pack is selected off, the respective pack main valve shuts off bleed air supply and the other pack increases its output flow rate to 140 per cent of the normal flow rate. A single pack is capable of maintaining cabin altitude by itself at the maximum operating altitude of FL 350. Air-conditioning pack 1 is located underneath the floor of the flight deck on the left-hand side, which is just forward of the forward lavatory.

Figure 2: F28 bleed air supply



Source: ATSB

Captain (PM) comments

The captain provided the following comments:

- No systems associated with air-conditioning/pressurisation were recorded as unserviceable before the flight.
- The emergency unfolded 'very quickly' with multiple faults and therefore knowledge of the emergency drills and procedures needed to be 'second-nature'. By the time they had

12 Pressure difference between the external atmosphere and aircraft cabin.

performed their initial drills and checked the deployment of the passenger emergency oxygen, the cabin pressure altitude was already indicating in excess of 25,000 ft.

- The loud 'whooshing' noise was similar to the noise heard in the simulator during rapid decompression training.
- They did not feel any physiological effects during the loss of pressure and responded in accordance with their training.
- Their simulator training was comprehensive, allowing them to follow procedures while maintaining sufficient 'spare mental capacity' to deal with all the problems that unfolded in a logical and methodical manner.

Cabin manager comments

The cabin manager provided the following comments:

- One passenger reported to them there was an unusual smell and the PM indicated to them that this was probably from the failed air-conditioning pack.
- Prior to the oxygen mask deployment, they felt a sensation in their ears, 'like on a descent'. Another cabin crewmember commented to the cabin manager that they looked pale, and another cabin crewmember reported to them that they felt a loss of breath.
- After the instruction to sit down for the expected excessive cabin altitude, they were concerned that the sleeping passengers might not get their oxygen masks on when they deployed.
- About two minutes after sitting down, they heard a loud bang and the passenger emergency oxygen deployed.
- Some passengers had trouble fitting their oxygen mask, so the cabin crew used a combination of hand signals and verbal communication to assist them while remaining in their jump seats.
- They felt that the incident was managed in a 'textbook' manner.
- Another member of the cabin crew reported to them that they saw sticky tape covering the emergency oxygen in the forward lavatory, which prevented its deployment.

Maintenance findings and corrective actions

The operator's maintenance investigation of the incident found the following:

- There was a visual indication of duct over-temperature on air-conditioning pack 1.
- There was a controller fault on air-conditioning pack 1 and the flight deck temperature control was not working. The controller was replaced.
- A 'heavy leak' was found from the recirculation duct during investigation of air-conditioning pack 2. The recirculation duct was replaced.
- One of the outflow valves was found to be a 'bit sticky'. The primary and secondary outflow valves were replaced. However, this did not have any effect on the pressurisation test results.
- There was a 'massive leak' from the inlet and outlet of air-conditioning pack 1. Pack 1 was removed and a large hole found in the plenum duct[13] (Figure 3). The plenum duct and primary and secondary heat exchanger were replaced on pack 1. Aircraft pressurisation was then tested and found to be serviceable (including operations with either pack 1 or pack 2 turned off).

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[13] The plenum duct houses air at positive pressure (pressure higher than surroundings), and equalises pressure for a more even distribution in order to manage irregular supply or demand.

Figure 3: Ruptured plenum duct

Source: Operator

Operator comments

The airline operator provided the following comments:

- The pack 1 fault was triggered by a compressor outlet overheat switch, which is located in the compressor outlet duct of the number 1 air-conditioning pack.
- The auto-throttle 1 fault was probably linked to the leaks in the air-conditioning ducts, which resulted in a conflict between the demands of the pressurisation computers and the operation of the auto-throttle system.
- The reason why the passenger emergency oxygen did not deploy in the forward lavatory is under investigation.
- The depressurisation can be attributed to pack 2, being the sole air supply, having a 'heavy' recirculation duct leak, which would not allow pack 2 to pressurise the aircraft.

Similar occurrence

On 11 April 2016 VH-NHF suffered a number 2 bleed valve fault, which was reset once and then failed a second time. The pilots initiated a return to Perth. During the transit, the number 1 bleed valve failed. The pilots initiated their emergency drills, which included the use of emergency oxygen and a precautionary descent to FL 140. The excessive cabin altitude warning did not activate and during the descent, the number 1 bleed valve was reset. A normal approach and landing was performed at Perth.

ATSB comment

Air-conditioning pack 1 is located on the left side of the aircraft underneath the floor of the flight deck, just aft of the left seat, which places it close to underneath the floor of the forward lavatory. The pack 1 plenum duct likely ruptured at about FL 305 to produce what the aircraft captain described as a loud 'whooshing' noise and what the cabin manager described as a 'suction' noise. According to Flight Safety Foundation *Human Factors and Aviation Medicine*, the immediate donning of oxygen masks by the flight crew, following an 'excessive cabin altitude' warning, is the essential first step to surviving a high altitude depressurisation.

The subsequent maintenance investigation found duct leaks from both air-conditioning systems. However, only the leak from air-conditioning pack 1 triggered an alert to the pilots, and that fault was associated with an overheat condition. In accordance with the operator comments, the rapid increase in the cabin pressure altitude rate of climb, which occurred when the flight crew turned pack 1 off, indicates that pack 2 alone could not supply a sufficient quantity of air to the distribution ducting to maintain cabin altitude. The systems were only able to re-pressurise the aircraft following the descent to 10,000 ft (the demands on the pressurisation system were substantially reduced) [14] and the successful reset of pack 1.

Safety action

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

Operator

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

All parts removed from the number 1 air-conditioning pack will be forwarded to the manufacturer, or authorised repair organisation, for further technical investigation to determine the cause of the failure of the plenum duct.

Safety message

The incident started in a subtle manner as an unusual noise, then quickly escalated to a compound emergency. After some initial uncertainty regarding the noise, the flight crew quickly recognised the true nature of the emergency that was unfolding. The captain and cabin manager both commented that the emergency then unfolded in accordance with their expectations and there were several factors that assisted their emergency management. These factors included:

- their training experiences, which they felt closely matched their emergency experience
- procedural knowledge of their initial drills
- the fact that their colleagues were trained to the same level as themselves.

This incident highlights the importance and value of high-quality training for both flight crew and cabin crew. Quality training clearly assists in equipping crewmembers with the required knowledge and confidence to effectively respond to a time critical emergency. A sound understanding of emergency procedures is particularly important in ensuring that crews not only respond to an emergency appropriately, but also retain the capacity to deal effectively with other potentially complicating factors. Similarly, a sound understanding of aircraft systems supports effective crew decision making with respect to the best course of action when confronted with abnormal circumstances.

Additional information regarding how to respond to an aircraft depressurisation is provided in the following ATSB education bulletins:

- *Staying safe during an aircraft depressurisation – Passenger information bulletin* (AR-2008-075 (1))
- *Aircraft Depressurisation – Cabin crew information bulletin* (AR-2008-075 (2)).

[14] The pressure difference between 30,500 ft aircraft altitude and 6,000 ft cabin altitude is about 7.51 psi, whereas the pressure difference between 10,000 ft aircraft altitude and 1,500 ft cabin altitude is about 3.81 psi (1 atmosphere = 14.7 psi). Therefore, at 10,000 ft, the demands on the pressurisation system were substantially reduced.

General details

Occurrence details

Date and time:	7 June 2016 – 1020 WST	
Occurrence category:	Serious incident	
Primary occurrence type:	Depressurisation	
Location:	49 km west Newman, Western Australia	
	Latitude: 23° 28.50’ S	Longitude: 119° 19.78’ E

Aircraft details

Manufacturer and model:	Fokker B.V. F28	
Registration:	VH-NHF	
Serial number:	11458	
Type of operation:	Charter - Passenger	
Persons on board:	Crew – 5	Passengers – 28
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Incorrect configuration involving Boeing 717, VH-YQV

What happened

On 20 June 2016, a captain and first officer, employed by Cobham Aviation Services, conducted a QantasLink flight from Sydney Airport, New South Wales, to Canberra Airport, Australian Capital Territory, in a Boeing 717-200 aircraft, registered VH-YQV.

The aircraft arrived in Canberra at about 0720 Eastern Standard Time (EST), and the first officer then conducted an external inspection of the aircraft, while the captain prepared the cockpit including the take-off data for the next sector to Sydney. The captain wrote the reduced-thrust take-off data onto the take-off and landing data (TOLD) card, including a flex temperature[1] of 40 °C, which was obtained from a table in the regulated take-off (RTO) book, an engine pressure ratio (EPR)[2] of 1.39, aircraft take-off weight, flap setting 5, and the take-off reference speeds (V speeds).[3] As the runway was wet, the V speeds were obtained manually from a table in the RTO book.[4]

After completing the external inspection, the first officer returned to the cockpit and the flight crew checked the take-off data in accordance with standard procedures. The first officer assessed that based on the environmental conditions, the flex temperature should be 39°. The first officer amended the TOLD card by striking through the 40 and writing 39 next to it, and similarly amended the V speeds based on the manual V speeds provided in the table for that flex temperature.

The captain was the pilot flying[5] for the sector to Sydney, so commenced briefing for the flight. The captain read out the data from the TOLD card, including the flex temperature and EPR, and the first officer entered the flex temperature and V speeds into the take-off page of the flight management system (FMS), which then calculated an EPR.

The flight crew then completed the cockpit checklist down to the last four items, in accordance with standard procedures. At that time, a member of the cabin crew entered the cockpit to advise the flight crew that an additional 22 passengers would be boarding the flight. As the aircraft take-off weight would increase by about 2 tonnes, the first officer recalculated the take-off data. The newly derived flex temperature was 34°, and as there was not much room left on the TOLD card, the first officer overwrote the previous figure of 39 with 34. The first officer then obtained the new V speeds, which the captain crosschecked and the first officer wrote them on the TOLD card.

The aircraft communications, addressing and reporting system (ACARS) then chimed with the loadsheet coming through on the printer, and at about the same time, a cabin crewmember entered the cockpit to confirm passenger numbers and ground personnel communicated over the intercom with the flight crew about removing the wheel chocks. After entering the zero fuel weight

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1 Flex temperature is a calculated outside temperature used for a reduced thrust take-off. The flex temperature (which is hotter than actual outside temperature) is used for generating take-off parameters rather than the actual outside temperature. It takes into account the runway length and aircraft weight to ensure the aircraft can take off within the runway distance available and maintain the required obstacle clearance during the subsequent climb. The aim is to prolong engine life.

2 The engine pressure ratio, or EPR, is a pressure ratio indicative of engine thrust. The pressure is sensed by two probes, one ahead and one aft of the jet engine fan.

3 Take-off reference speeds or V speeds assist pilots in determining when a rejected take-off can be initiated, and when the aircraft can rotate, lift-off and climb.

4 For a dry runway, the V speeds used would have been automatically generated by the flight management system.

5 Pilot flying (PF) and pilot monitoring (PM) are procedurally assigned roles with specifically assigned duties at specific stages of a flight. The PF does most of the flying, except in defined circumstances; such as planning for descent, approach and landing. The PM carries out support duties and monitors the PF’s actions and aircraft flight path.

from the loadsheet into the FMS and crosschecking the take-off weight in the FMS against the take-off weight derived on the TOLD card, the captain called for the first officer to enter the revised manually derived V speeds from the TOLD card into the FMS.

The standard procedure then was for the captain to call ‘re-flex’ before entering the amended flex temperature and flap setting from the TOLD card into the FMS. The captain was holding the TOLD card and reported stating ‘39’ as the flex temperature, having misread the ‘34’. The first officer could not recall checking the flex temperature in the FMS at that time, and thought it may have been omitted due to the interruptions.

The crew reported that the EPR calculated by the FMS based on the flex temperature and environmental conditions was 1.39. (The flight data showed that the commanded EPR at that stage was actually 1.38.) The EPR obtained from the RTO book (for flex temperature of 34°) and written on the TOLD card was 1.41. The flight crew crosschecked the FMS EPR with the TOLD card EPR, and although there was a discrepancy of 0.2, it was within the 0.3 margin allowed at that stage.[6]

After obtaining the required air traffic control clearances, the captain taxied the aircraft to the runway and commenced the take-off at about 0812. In accordance with standard procedures, the captain then moved the thrust levers forward and checked for an even spool-up of the engines to an EPR of 1.2. The captain then called ‘auto flight’ and the first officer engaged the auto-flight system. This action caused the thrust levers to move to a position where the EPR from the FMS was achieved. The captain then called ‘check thrust’ and the first officer saw that the EPR was 1.38, instead of the required EPR of 1.41 as written on the TOLD card. In accordance with standard procedures, the first officer then moved the thrust levers forward to achieve 1.41 EPR.

The flight crew thought that the aircraft was then correctly configured for the take-off, with the correct EPR, thrust and flap settings and V speeds, and the captain continued the flight. However, after about 4 seconds at 1.41, the EPR returned to 1.38 for the take-off as the thrust lever position returned to that set by the auto-flight system based on the EPR value in the FMS.

During the initial climb, the first officer identified that the flex temperature set in the FMS was 39 instead of 34. As the short sector to Sydney was busy, the crew waited until the aircraft had arrived in Sydney before discussing the incident. Both members of the flight crew assessed that tiredness due to the early start may have contributed to the flex temperature error, but that they were fit to continue to operate for the remainder of the day’s duty.

Flight data

The aircraft operator provided the ATSB with a copy of the quick access recorder (QAR) data for the incident flight. As depicted in Figure 1, the data showed the thrust lever angle set at about 25° and the EPR at 1.38 early in the take-off run. After about 4 seconds at that setting, the thrust lever angle increased to about 26° as the commanded EPR, followed closely by the actual EPR, increased to 1.41. However, after about 4 seconds at 1.41 and a further 6 seconds at 1.39, the EPR reduced to 1.38 and thrust lever angle to about 25°, where they remained for the take-off.

This indicates that although the first officer manually moved the thrust levers forward, as the auto-throttle system was engaged, it then overrode the manual thrust lever position and returned the EPR to the value set in the FMS, which was the target thrust setting. At the time, the computed airspeed was 54 kt. When the airspeed reaches 80 kt in the take-off roll, the auto-throttle system mode changes from ‘take-off thrust’ to ‘take-off clamp’ mode. In clamp mode, the auto-throttle servo does not have power and the thrust levers do not move automatically. However, in take-off thrust mode (prior to 80 kt), the flight crew would have to disengage the auto-throttle system to set the thrust manually, or maintain pressure on the levers until the airspeed reached 80 kt.

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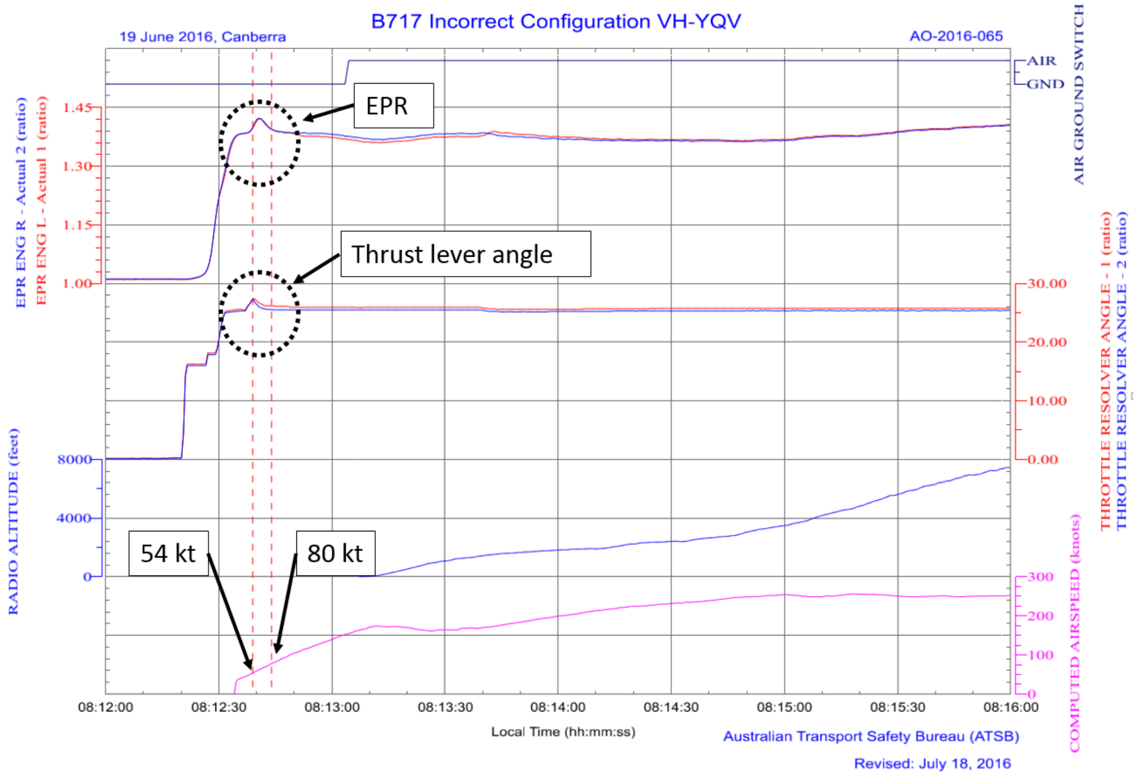
[6] A change in bleed configuration, such as selecting air conditioning packs on or off, can change the EPR value. Therefore there is a small discrepancy allowed while parked and during taxi, but the two figures must match at take-off

Figure 2: Graph of flight data from the incident flight



Source: QAR data supplied by the aircraft operator analysed by the ATSB

Flight crew comments

During the approach into Canberra from Sydney, the cloud base was at the minima.[7] The captain commented that the workload on an instrument approach down to the minima was high, and would generally result in a reduced state of arousal after landing and shutdown in response.

The flight crew commented that a combination of distraction by cabin crew and ground personnel while re-entering data, a reduced state of arousal following high workload instrument approach, and possibly tiredness from an early start may have contributed to their omitting to enter the correct flex temperature into the FMS.

Although the captain recalled misreading 39 instead of 34, the first officer could not recall the captain calling 're-flex', and commented that it was unlikely to have been called and then not completed. The first officer thought it was more likely that they entered the new V speeds but had omitted to check that the flex temperature written on the TOLD card matched that in the FMS.

Normally by the time they are getting to the third set of amended numbers, the first officer would start a new TOLD card. However, as it was approaching the scheduled departure time, the first officer elected to overwrite the existing figures. The captain further commented that in future, if there were any more than two corrections made to the supplement data on the TOLD card, they would write out a new card.

The captain commented that this incident provided a good example of how adherence to standard operating procedures helps to mitigate errors. While the initial crosscheck prior to taxiing showed a discrepancy between the TOLD card and FMS EPR values, as it was within the permitted tolerance, the flex temperature error was not identified at that time. When the first officer checked the thrust (and EPR) during the take-off run, the too-low EPR setting was identified and the thrust

[7] For a precision approach, the minima is defined as a decision altitude at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

levers set to obtain the correct EPR. Hence following the standard operating procedures provided sufficient risk control to identify and correct the error.

Tiredness

The flight crew signed on at 0505 for a four-sector flight duty from Sydney. The scheduled departure time for their first flight from Sydney was 0620 and the flight crew were required to sign on 1 hour and 15 minutes prior. In addition, the crew had to allow 30 minutes to transfer from the long-term carpark, pass through airport security, and sign on in the crew room in the domestic terminal at Sydney Airport.

The captain reported waking up at 0340 and the first officer at 0305, and both crewmembers reported conducting a self-assessment of their fitness to fly. The first officer reported feeling 'somewhat tired' having had a broken night's sleep, but had the previous four days off work and did not feel fatigued. The captain also reported feeling tired having woken up early, they assessed they were not fatigued, and were fully fit to fly. Both the captain and first officer commented that the early start times generally caused a feeling of tiredness, but did not affect their ability to operate the aircraft.

Cobham operates flight and duty time limitations based on Civil Aviation Order 48 and an exemption, and had not, nor was required to have, implemented a fatigue risk management system. The flight crew reported that the company operations manual included a statement that it is the flight crew's responsibility to determine their fitness to fly.

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 safety action in response to this occurrence.

Aircraft operator

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

Communication to flight crew

The operator will remind pilots to use a new TOLD card in the event that the card data is being changed and comprehension of these changes is not clear. Pilots will be advised of the investigation by its inclusion in the company's staff safety magazine.

Safety message

Inaccurate take-off reference data has potentially serious consequences. ATSB Aviation Research and Analysis Report AR-2009-052 (*Take-off performance calculation and entry errors: A global perspective*) documents a number of accidents and incidents where take-off performance data was inaccurate. The report analyses those accidents and incidents, and concludes:

> *… it is imperative that the aviation industry continues to explore solutions to firstly minimise the opportunities for take-off performance parameter errors from occurring and secondly, maximise the chance that any errors that do occur are detected and/or do not lead to negative consequences.*

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry. One of the safety concerns relates to data input errors.

SafetyWatch

General details

Occurrence details

Date and time:	20 June 2016 – 0810 EST	
Occurrence category:	Incident	
Primary occurrence type:	Incorrect configuration	
Location:	Canberra Airport, Australian Capital Territory	
	Latitude: 35° 18.42' S	Longitude: 149° 11.70' E

Aircraft details

Manufacturer and model:	The Boeing Company 717	
Registration:	VH-YQV	
Operator:	Cobham Aviation Services	
Serial number:	55193	
Type of operation:	Air transport high capacity - Passenger	
Persons on board:	Crew – 5	Passengers – 91
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Personal electronic device fire in-flight involving Boeing 747, VH-OJS

What happened

On 21 June 2016, a Qantas Airways Boeing 747-438 aircraft, registered VH-OJS, operated flight QF11 from Los Angeles, California, United States to New York, New York, United States.

At about 0700 Coordinated Universal Time (UTC), a cabin crewmember responded to a request for assistance from a passenger seated in business class seat 3A. The passenger advised the crewmember of a missing personal electronic device (PED). The PED was identified as containing a lithium type battery. The crewmember, along with the passenger, searched around the seat for the missing PED. While searching, the seat position was moved. As the seat moved, the passenger in the next seat observed the PED within the seat mechanism. The seat was then inadvertently moved, resulting in the PED being crushed (Figure 1). The crushed PED immediately began hissing and emitting smoke. Moments later, the PED ignited. A second crewmember then initiated the basic fire drill.

The second crewmember obtained a fire extinguisher, and as they proceeded toward seat 3A, they advised a third crewmember of the incident and requested assistance. This crewmember also obtained a fire extinguisher, and proceeded toward seat 3A. The customer service manager (CSM) and another crewmember observed the activity and also followed, providing additional support.

When the cabin crewmembers carrying fire extinguishers arrived at seat 3A, they observed an orange glow emanating from the seat. A crewmember discharged a fire extinguisher into the seat, extinguishing the glow. At this time, the CSM acted as a communicator with the flight crew to inform them and keep them updated on the incident.

After confirming the PED fire had been extinguished, the cabin crew attempted to remove the PED in order to place the device in water, in accordance with lithium type battery fire procedures. The PED could not be removed without further damage and risk of fire. Therefore, the cabin crew elected to leave the device in place and position a crewmember with a fire extinguisher near seat 3A for the remainder of the flight. About 10–15 minutes after the incident, this crewmember identified further heat coming from the crushed PED. They again discharged the fire extinguisher onto the PED, eliminating the heat.

After confirming the incident was contained, the CSM advised the captain that the situation was under control. The captain discussed the incident with the first officer, and considered the event had been dealt with appropriately. The flight proceeded to New York and landed about 40 minutes later without further incident.

Two passengers reported feeling unwell after the event, but it was unclear if this was as a result of the incident. The aircraft seat sustained minor damage.

Figure 3: Crushed PED after removal from seat

Source: Qantas

Cabin crew comment

The responding cabin crewmember commented that the provision of designated storage close to the charging port could assist in preventing PEDs entering seat structure.

Passenger comment

The passenger in seat 3A commented that the amenities pack provided to passengers in this seat type could be changed to include PED storage. This could assist preventing PEDs entering the seat structure.

Operator investigation report

The aircraft operator investigated the incident and provided a copy of their investigation report to the ATSB. The report included the following:

- A review of reported events revealed 22 similar occurrences of trapped or crushed PEDs. Seven of these occurrences resulted in smoke and/or heat being produced. This incident was the first event to result in fire.
- The investigation determined that the likely area for the PED to intrude into the seat mechanism was adjacent to the seat belt anchor point. This area becomes more exposed as the seat reclines towards the flat position.
- Mesh netting within the seat structure is designed to capture objects that fall behind the seat. Damage to seat 3A consisted of an approximate 5 cm melt area to this mesh netting. There was no other damage noted to the seat structure.

Lithium battery thermal runaway

The United States Federal Aviation Administration (FAA) document *Safety alert for operators SAFO 09013: Fighting fires caused by lithium type batteries in portable electronic devices*, and the associated document *SAFO 09013 Supplement*, detail the risk of thermal runaway in lithium type batteries:

> Lithium batteries are capable of ignition and subsequent explosion due to overheating. Overheating may be caused by shorting, rapid discharge or overcharging. Overheating results in thermal runaway, which is a chemical reaction within the battery causing the internal temperature and pressure to rise. The result is the release of flammable electrolyte from the battery and, in the case of disposable lithium batteries, the release of molten burning lithium. Once one battery cell goes into thermal runaway, it produces enough heat to cause adjacent battery cells to also go into thermal runaway. This produces a fire that repeatedly flares up as each battery cell in turn ruptures and releases its contents.

SAFO 09013 Supplement also details the following information on fighting fires caused by lithium type batteries:

- Relocate passengers away from the device.
- Utilise a halon, halon replacement, or water fire extinguisher to prevent the spread of the fire to adjacent battery cells and materials.
- Pour water, or other non-alcoholic liquid, from any available source over the cells immediately after knockdown or extinguishment of the fire.

  Only water or other non-alcoholic liquid can provide sufficient cooling to prevent re-ignition and/or propagation of the fire to adjacent batteries. Water, though it may react with the tiny amount of lithium metal found in a disposable battery, is most effective at cooling remaining cells, stopping thermal runaway and preventing additional flare-ups. Significant cooling is needed to prevent the spread of fire to additional cells in a battery pack.

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.

Seat manufacturer

As a result of this occurrence, the aircraft operator has advised the ATSB that the seat manufacturer is developing design solutions to prevent ingress of PEDs into the seat structure.

Aircraft operator

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

Changes to passenger briefings

An enhanced passenger briefing has been released to include:

If you lose your electronic devices at any time, it's important you don't move your seat as this could severely damage your device and may be a fire hazard. Please contact a crew member who will be able to recover your device.

A cabin crew service brief has been released which includes:

Passenger announcement to remind passengers not to move seats when devices have been lost.

Individual interactions between cabin crew and passengers when preparing the bed to include a discussion to raise passenger awareness of the possibility that the PED could be crushed if it is lost during the flight.

Establishment of working group

A working group has been established to develop further solutions for this issue.

Safety message

This incident serves as an excellent example of an effective response to an emergency situation. The cabin crew quickly implemented the basic fire drill procedure. This defined the roles and responsibilities of the responding crew, enabling a rapid and coordinated response to the incident using all available resources. As a result, the incident was quickly and effectively contained. The effective implementation of this procedure also ensured the flight crew were kept informed as the situation developed.

This incident also highlights the hazards of transporting lithium-ion battery powered PEDs aboard aircraft. The Civil Aviation Safety Authority has released information on the safe carriage of lithium type battery powered devices aboard aircraft in the web page: *Travelling safely with batteries* and pamphlet: *Is your luggage safe?*

General details

Occurrence details

Date and time:	21 June 2016 – 0700 UTC	
Occurrence category:	Serious incident	
Primary occurrence type:	Fire	
Location:	500 km WNW of John F. Kennedy International Airport, United States	
	Latitude: 42° 16.000' N	Longitude: 79° 22.500' W

Aircraft details

Manufacturer and model:	The Boeing Company 747	
Registration:	VH-OJS	
Operator:	Qantas Airways	
Serial number:	25564	
Type of operation:	Air transport high capacity – Passenger	
Persons on board:	Crew – Unknown	Passengers – Unknown
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Minor	

Piston aircraft

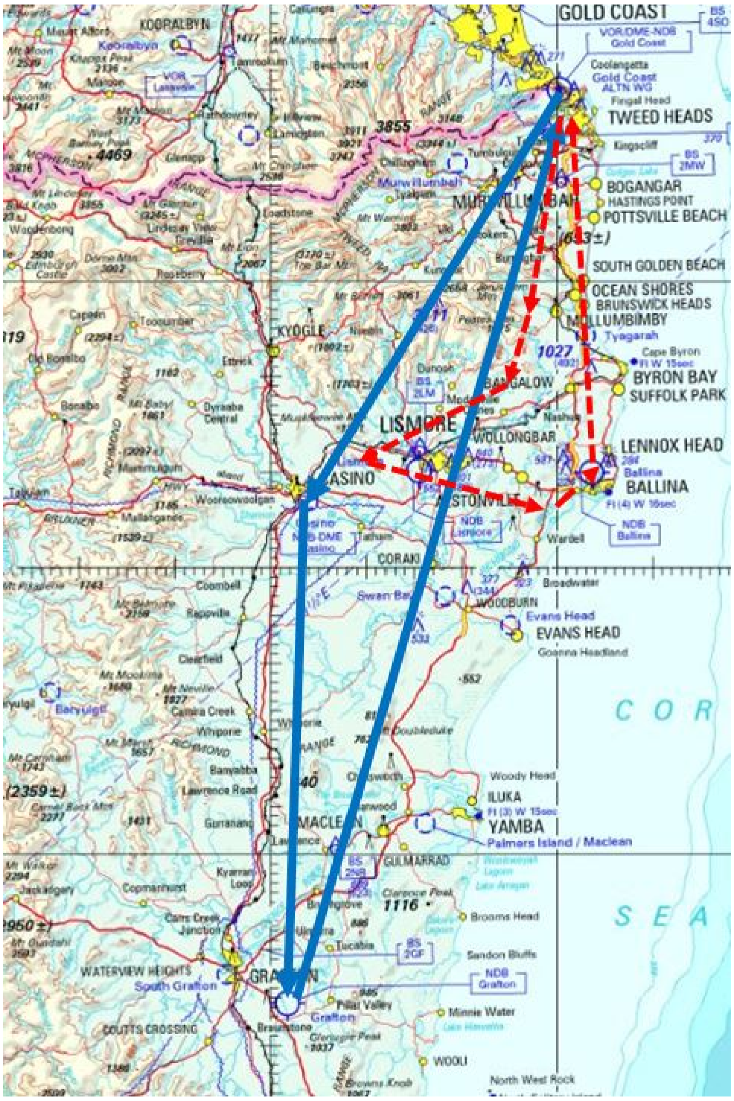
VFR into IMC involving Cessna 172, VH-EOV

What happened

On 19 March 2016, a student pilot prepared for their first solo navigation training exercise in Cessna 172, registered VH-EOV (EOV). The flight was planned from the Gold Coast Airport, Queensland (Qld), overhead Casino, and onto Grafton Airport, New South Wales (NSW). The return leg plan was from Grafton Airport direct to the Gold Coast Airport (Figure 1 blue lines).

Prior to departure, the pilot and their instructor checked the flight plan and discussed the weather forecast. They both then checked the live weathercam[1] at Lismore Airport, NSW, as Lismore is close to Casino. The weathercam showed some fog and low cloud, with clear skies above. As a final assessment, the pilot and instructor walked outside and visually assessed the conditions.

Figure 1: Flight planned track (blue), approximate track flown (red)



Source: Airservices Australia Armidale World Aeronautical Chart annotated by ATSB

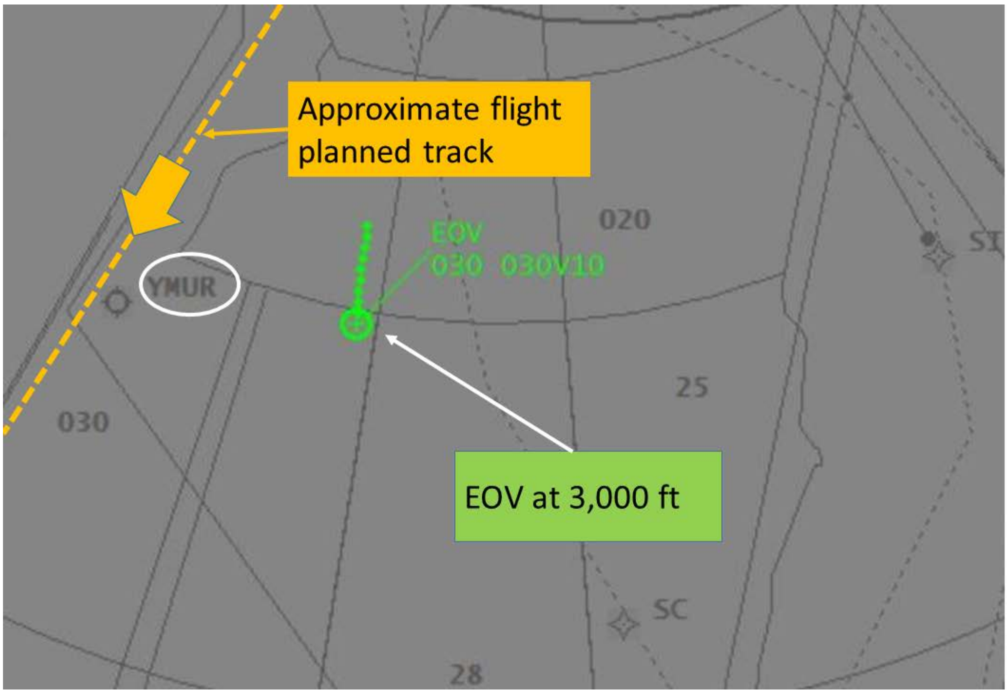
[1] Weathercam is a network of real time cameras located around Australia recording real time weather.

The instructor was satisfied that the low cloud at Lismore would soon burn off and the pilot would be able to complete the visual flight rules (VFR)[2] navigation exercise at the planned level of 6,500 ft above mean sea level. The instructor then prepared to depart on another flight. About thirty minutes later, the instructor taxied past EOV in another aircraft and noted that the pilot was still preparing EOV for the flight.

At about 1012 Eastern Standard Time (EST), EOV departed on runway 14, about 1.5 hours after they were approved by the instructor to depart. Due to jet traffic, the Gold Coast Tower controller instructed the pilot to make a right turn after take-off (on to their planned track) and climb to 2,500 ft. About two minutes later, the Tower controller cleared EOV to climb to 3,000 ft. As the pilot initiated the right turn, they assessed that the weather conditions on their intended track were worse than they had expected, with the visibility ahead reduced by haze and cloud.

Part way through the right turn, the pilot unintentionally stopped the turn and started to track in a southerly direction, instead of south-westerly toward Casino. Noting that the aircraft was not tracking as expected, the Tower controller asked the pilot to confirm their current heading. The pilot asked the controller to 'standby'. With no further response from the pilot, the controller then instructed them to turn right onto a heading of 250°. However, the pilot continued to track about 40° left of track (Figure 2). To assist the pilot, the controller advised them of their current position, cleared the aircraft from that position direct to Casino, and as per normal procedure, and instructed the pilot to change frequency to contact Brisbane Approach.

Figure 2: Flight planned track to Casino in yellow. EOV (green) tracking to the east of Murwillumbah Airport (YMUR, white circle) in a southerly direction



Source: Airservices Australia – annotated by ATSB

The aircraft was now very close to cloud and the pilot had turned all their attention to this threat. At 1020, the pilot contacted the Approach controller to request a climb to not above 5,500 ft, as this would give them flexibility to climb or descend as required to avoid entering cloud. The Approach controller advised the pilot there would be a short delay prior to this request being approved. During this period, EOV entered cloud.

2 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.

The pilot spent the next few minutes focussed solely on the flight instruments but did not inform the controller that they were in cloud. The Approach controller then approved the pilot to climb to 5,000 ft. While still in cloud, the pilot began the climb, and inadvertently started to turn left. The Approach controller questioned what heading the pilot was on and when the pilot could not answer correctly, they suggested a heading for Casino. The pilot turned on to the suggested heading. The pilot then observed a break in the cloud below them and requested a descent. The Approach controller approved the descent and asked the pilot to confirm that operations were normal. The pilot replied that all their instruments were working correctly. The pilot then descended to 1,500 ft and exited the cloud. The pilot later estimated that they were in cloud for approximately three minutes.

The pilot had a brief radio discussion with their instructor, who was flying in a different aircraft in the vicinity. Their instructor advised them that Casino Airport was closed. Making the decision to discontinue the navigation exercise and to return to the Gold Coast along the coast, the pilot turned EOV to the east. At 1100, the pilot advised Brisbane Centre (Centre) air traffic control (ATC) that they were about 3 NM east of Lismore, and were now tracking to the coast. At 1105, Centre ATC identified EOV on radar 4 NM south of Ballina, NSW.

The pilot of EOV did not change the radio frequency to the common traffic area frequency (CTAF) as required when transiting within 10 NM of Ballina. At 1108, as a regular public transport jet aircraft was inbound to Ballina, the Centre controller attempted to call the pilot of EOV to advise them of the conflicting traffic. However, the pilot did not respond. The Centre controller then issued a safety alert to the pilot of EOV advising the jet traffic was now at 1,100 ft (the same level as EOV). The pilot in EOV acknowledged this alert advising that they had the jet traffic sighted. The two aircraft passed within 1.7 NM of each other at a similar level.

As EOV tracked north along the coast toward the Gold Coast (red line in Figure 1), the Centre controller advised the pilot of a conflicting aircraft tracking southbound. The pilot acknowledged this call and advised they were looking for this traffic. The two aircraft passed without incident. The pilot then continued to the Gold Coast and landed without incident.

Pilot experience and comments

At the time of the incident, the pilot had logged about 46 flying hours. Three hours of this was instrument[3] flight training.

The pilot provided the following comments:

- The weather had changed very quickly, and that it was different to that expected.
- They felt no pressure to conduct the flight. They had been briefed to ‘turn back’ to the Gold Coast if at any time they felt uncomfortable with the weather.
- They did not specifically alert ATC that they had entered cloud. They had however, advised ATC that they were uncertain of the aircraft’s position, and accepted assistance in that regard.
- They had attempted to program the “Direct To” function on the KLN89B GPS installed in the aircraft, but had not been able to get this to work. They were not confident in the use of the navigation aids (VOR and ADF).

The pilot reported that the level of stress they were under after entering cloud had added to the normal stress level of conducting a first solo navigation exercise. This had made processing information much more difficult, but they remained focussed on keeping the aircraft level using their limited experience relying solely on the flight instruments

The pilot had sat the Private Pilot Licence theory test the day prior to the flight, and therefore the week before the flight had been busy.

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3 Without visual outside reference to simulate instrument meteorological conditions. Can be in a synthetic trainer or in an aircraft with an instructor with simulated IMC being attained by the trainee wearing a special ‘instrument hood’.

The pilot advised the best safety message to convey to other pilots with limited experience was to stay aware of the terrain around you. If the weather is not as expected, make an early decision to turn back.

Instructor experience and comments

The instructor held a Commercial Pilot's Licence with a grade 2 training endorsement.

This instructor had been the pilot's regular instructor and had conducted all the previous dual navigation exercises with them. The instructor reported that the student had previously experienced some difficulty with departures from the Gold Coast, but this had been addressed with training.

The instructor provided the following comments:

- They were surprised when the pilot had not departed until about 1.5 hours after being authorised to depart.
- They also found the weather worse than forecast and were surprised how much cloud was still around.
- By the time the pilot did depart, a safer cruising level would have been about 2,500 ft.
- All students at the flying school are exposed to basic use of the navigation aids at this stage of their training. Loading a flight plan into the GPS is demonstrated, but it is not expected that the student would be proficient in the use of these aids at this stage.
- While on another flight in the Casino area, they had advised the pilot by radio that Casino Airport was unserviceable.
- The student had done well in the instrument flight component of their training.
- They felt comfortable with the decision to let the pilot depart on the solo exercise that day.

Flying School comments

The flying school reported that the student departed with the intention of reaching the planned altitude of 6,500 ft with broken cloud at 3,500 ft without carefully considering alternative altitudes.

The school also advised that the student incorrectly used the VHF Omnidirectional Radio Range (VOR) for establishing the departure track and did not identify the cloud ahead in a timely manner.

The student did not clarify with ATC that a climb was required in order to remain in VMC and when they entered cloud, they did not follow the procedure to ensure they returned to VMC as quickly as possible.

Weather

Initial weather reports indicated that the conditions would be suitable for the solo flight. The Gold Coast Airport Aerodrome Forecast was for scattered cloud at 2,000 ft above ground level, with broken cloud at 3,500 ft. The Area Forecast pertinent to the planned flight indicated that the broken low cloud would lift by 0900.

ATSB comment

Pilots are encouraged to make conservative decisions when considering how forecast weather may affect their flight. If poor weather is encountered en route, timely and conservative decision making may be critical to a safe outcome. It is advisable to make a positive decision to turn back if the weather is not as planned and outside the capability of their experience level.

The ATSB also encourages pilots to seek assistance from ATC as soon as they find themselves in difficulty, or preferably, before the situation escalates to that point, so that ATC can provide timely assistance.

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 – flying school

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

A formalised brief will be given to all students prior to their first training area solo flight.

This brief will have an emphasis on:

- maintaining situational awareness when weather conditions are less than optimal
- the importance of maintaining VMC at all times will be re-addressed
- the importance of conducting a 180° turn on instruments if a pilot does inadvertently find themselves in cloud
- when encountering cloud, to include the phrase 'due cloud' in transmissions with ATC
- the importance of seeking early assistance from ATC, rather than letting the situation deteriorate
- when to use 'request' and when to use 'require' when seeking a clearance from ATC
- be clear on phraseology like 'not above' when requesting altitudes from ATC.

Safety message

SafetyWatch

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry.

Flying with reduced visual cues such as in this occurrence remains one of the ATSB's major safety concerns.

Number 4 in the Avoidable Accident series published by the ATSB titled 'Accidents involving pilots in Instrument Meteorological Conditions' lists three key messages for pilots:

- Avoiding deteriorating weather or IMC requires thorough pre-flight planning, having alternate plans in case of an unexpected deterioration in the weather, and making timely decisions to turn back or divert.
- Pressing on into IMC conditions with no instrument rating carries a significant risk of severe spatial disorientation due to powerful and misleading orientation sensations in the absence of visual cues. Disorientation can affect any pilot, no matter what their level of experience.
- VFR pilots are encourage to use a 'personal minimums' checklist to help control and manage flight risks through identifying risk factors that include marginal weather conditions.

Available from CASA's online store are:

Weather to Fly – This DVD highlights the dangers of flying in cloud, and how to avoid inadvertent VFR into IMC.

Flight Planning – always thinking ahead. A flight-planning guide designed to help you in planning and conducting your flight. This guide includes a 'personal minimums checklist.

SKYbrary have published an informative article looking at pre-flight risk management / and practical measures to maintain control for a limited period if a pilot had inadvertently flown VFR into IMC.

General details

Occurrence details

Date and time:	19 March 2016 – 1210 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	VFR into IMC	
Location:	near Gold Coast Airport, Queensland	
	Latitude: 28° 09.87' S	Longitude: 153° 30.28' E

VH-EOV

Manufacturer and model:	Cessna Aircraft Company 172R	
Registration:	VH-EOV	
Serial number:	17280699	
Type of operation:	Flying training – Training solo	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Fuel Starvation involving Lancair ES, VH-DFH

What happened

On 18 April 2016, at about 1030 Eastern Standard Time (EST), a Lancair ES aircraft, registered VH-DFH (DFH), was taxiing to depart from a private airstrip about 22 km NW of Mansfield (ALA), Victoria. The pilot was the only person on board the private flight.

After conducting an engine run-up, the pilot taxied the aircraft to take-off towards the east on the sealed strip. The pilot reported that the engine run-ups, taxi, and take-off were normal. During the initial climb, at about 500 ft, the engine suddenly lost power and the pilot established the aircraft in a glide, reducing the throttle and looked for a suitable forced landing area. Some engine power returned but was very intermittent and the engine was not producing the correct power for the engine control settings.

The pilot advised that conducting a forced landing straight ahead would have involved negotiating houses, trees, livestock, and the unknown nature of the ground surface. They assessed that sufficient height was available to return to the airstrip so commenced a turn to the left.

The pilot lined up with the airstrip landing towards the west. As the pilot considered that the aircraft had good height and speed, the pilot elected to extend the flaps half-way and subsequently extended the flaps to the full down position as the pilot was concerned that the aircraft would overshoot the airstrip.

The aircraft touched down about 25 m before the threshold on a grass area. The aircraft bounced slightly, touching down again on the grass area beside the airstrip. The left wing contacted an electric fence post and came to a stop a further 100 m after the initial touch down point (Figure 1). The pilot exited the aircraft after turning off all the electrical and engine controls. The pilot was not injured and the aircraft had minor damage.

Figure 1: DFH at the accident site

Source: Aircraft owner

Pilot comment

The pilot reported that the aircraft was inspected subsequent to the incident at an aircraft maintenance facility and no defects were found with the aircraft or engine. The maintenance personnel assessed that fuel starvation[1] was the probable reason for the power loss due to the way the aircraft had been parked on an incline prior to taxi and take-off. The pilot reported that the aircraft has two independent fuel tanks, one in each of the slim line wings. During the pre-flight inspection, the aircraft was situated with the left wing on the downhill side for a little over half an hour. It is believed that the fuel drained away from the fuel pick up toward the wing tip through a one-way flapper valve[2] reducing the quantity of fuel available in the sump area where the left wing fuel pick up is located. The pilot reported that the left fuel tank had been selected for the taxi and take-off.

The pilot reported that a self-briefing was routinely conducted before each flight for possible emergencies with decision points and suitable emergency landing areas considered.

The pilot indicated that the wind speed was about 10 knots gusting to about 25 knots from the NE which may have contributed to an undershoot of the airstrip.

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 owner

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

The owner is considering installing a placard in the aircraft to remind pilots when the aircraft is parked on an incline to consider which fuel tank to select for take-off.

Safety message

The ATSB booklet *Avoidable Accidents No. 3 - Managing partial power loss after take-off in single-engine aircraft* is available from the ATSB website and aims to increase awareness among flying instructors and pilots of the issues relating to partial power loss after take-off in single-engine aircraft.

During and after take-off, a partial power loss is three times more likely in today's light single-engine aircraft than a complete engine failure. There have been nine fatal accidents from 2000 to 2010 as a result of a response to a partial power loss compared with no fatal accidents where the engine failed completely. Analysis of the occurrences supports the need to raise greater awareness of the hazards associated with partial power loss and to better train pilots for this eventuality.

The booklet highlights the importance of:

- pre-flight decision making and planning for emergencies and abnormal situations for the particular aerodrome including a thorough pre-flight self-brief covering the different emergency scenarios.
- conducting a thorough pre-flight and engine ground run to identify any issues that may lead to an engine failure.

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1 Fuel starvation happens when the fuel supply to the engine(s) is interrupted although there is adequate fuel on board.
2 The flapper valve prevents fuel from sloshing around during normal flight.

- taking positive action and maintaining aircraft control either when turning back to the aerodrome or conducting a forced landing until on the ground, while being aware of flare energy and aircraft stall speeds.

Further information about the wing fuel tank one-way flapper valve is contained in an article published by the Lancair Owners & Builders Organisation, *Fuel system inspection & calibration* and is available from their website. The article discusses how the flapper valve prevents fuel from flowing away from the inner most fuel compartment where the engine fuel supply line is located. It also discusses how the small wing dihedral makes the aircraft particularly sensitive to the outward flow of fuel.

General details

Occurrence details

Date and time:	18 April 2016 – 1030 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Fuel related - starvation	
Location:	22 km NW Mansfield (ALA), Victoria	
	Latitude: 36° 54.68' S	Longitude: 145° 58.67' E

Aircraft details – VH-DFH

Manufacturer and model:	Amateur Built Aircraft LANCAIR ES	
Registration:	VH-DFH	
Serial number:	044	
Type of operation:	Private - Pleasure / Travel	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Minor	

Engine failure involving Piper PA-28, VH-IPO

What happened

VH-IPO

Aircraft operator

On the morning of 16 June 2016, a student and instructor planned to conduct a training flight in a Piper PA-28-161 aircraft, registered VH-IPO (IPO), from Mangalore Airport, Victoria.

The planned flight included time in the Mangalore training area before returning to the airport for circuit training. The aircraft departed Mangalore at about 0940 Eastern Standard Time (EST).

After completing the planned training area manoeuvres, the instructor conducted an orbit and asked the student to identify significant geographical points within the training area. At this time, the instructor noticed the tachometer indicated a slightly lower engine power output than expected for the selected throttle position. The instructor suspected carburettor icing[1] and applied carburettor heat.[2] This resulted in an immediate further drop in power and the instructor also reported the engine running slightly rough. After 10–15 seconds the power level returned to normal. After a further 10–15 seconds, the instructor selected the carburettor heat off and instructed the student to return to Mangalore. During the return flight, the instructor periodically applied carburettor heat without further indications of carburettor icing.

As the aircraft descended to Mangalore, the student selected carburettor heat on and joined the circuit for runway 36. Due to traffic in the circuit, the student conducted two go-arounds.[3] After the second go-around, the aircraft re-joined the circuit and the student prepared the aircraft for another approach. As the student prepared to turn onto the base leg, they applied the carburettor heat. At that time, the instructor observed a large drop in RPM. The instructor then took control of the aircraft and immediately turned onto the base leg. During the turn, the engine failed and the instructor continued the turn to track directly to runway 36. The instructor carried out the engine failure checklist, but was unable to restart the engine. The instructor then broadcast MAYDAY[4] on the Mangalore common traffic advisory frequency.

As the aircraft descended toward runway 36, the instructor assessed that they did not have sufficient altitude to glide to the runway. The instructor identified a field to the south of runway 36 and outside of the airport perimeter as suitable for a forced landing. As the aircraft descended through about 200 ft above ground level, the instructor conducted the shutdown checklist and landed the aircraft in the selected field.

The instructor and student were not injured in the incident and the aircraft was not damaged.

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1 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 which can restrict the airflow and interfere with the operation of the engine.

2 Carburettor heat is a system within the aircraft engine, selectable by the pilot, which draws heated air into the carburettor to prevent or attempt to remove ice.

3 Go-around, the procedure for discontinuing an approach to land, is a standard manoeuvre performed when a pilot is not completely satisfied that the requirements for a safe landing have been met. This involves the pilot discontinuing the approach to land and may involve gaining altitude before conducting another approach to land.

4 MAYDAY is an internationally recognised radio broadcast for urgent assistance.

Operator comment

The operator of IPO provided the following comment:

An engineer inspected the aircraft after the incident. The exhaust system, engine controls, fuel system and ignition system were inspected. Engine tests and a flight test were also performed. All checks indicated no faults with the aircraft or contaminants in the fuel system.

Carburettor icing

Induction icing, often referred to as carburettor icing, is the accumulation of ice within the induction system of an engine fitted with a carburettor. This ice forms as the decreasing air pressure and introduction of fuel reduces the temperature within the induction system. The temperature may reduce sufficiently for moisture within the air to freeze and accumulate. This build-up of ice restricts airflow to the engine, leading to a reduction in engine performance.

Environmental conditions influence the likelihood of carburettor ice forming, as shown by the Civil Aviation Safety Authority (CASA): *Carburettor icing probability* chart.

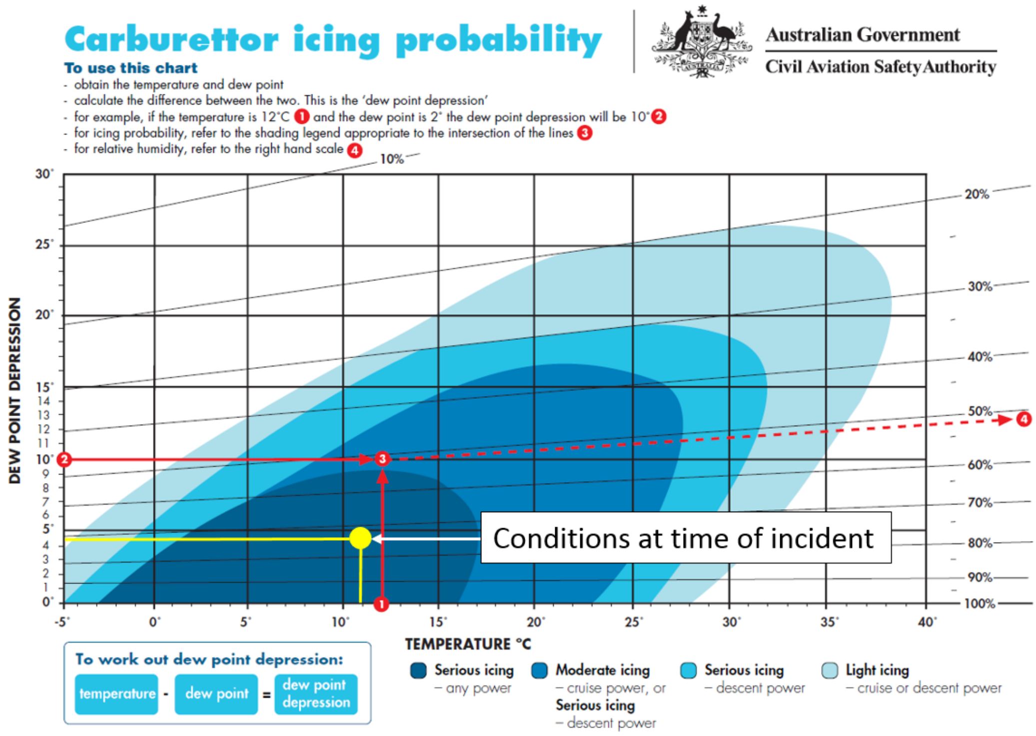
On the morning of the engine failure, the Mangalore aerodrome weather information service reported the following weather conditions.

Table 1: Weather conditions at Mangalore Airport on 16 June

Time	Temperature	Dew point
1000	8.6 °C	8.6 °C
1015	9.4 °C	9.1 °C
1030	9.6 °C	7.5 °C
1045	10.1 °C	7.3 °C
1100	10.6 °C	6.9 °C
1115	10.9 °C	6.5 °C

The carburettor icing probability chart shows the conditions at Mangalore Airport placed IPO in the serious icing zone for carburettor icing at the time of the incident (Figure 1). Carburettor icing could be expected at any power setting.

Figure 1: Carburettor icing probability chart showing prevalent conditions in yellow



Source: CASA modified by ATSB

The first indication of carburettor icing is normally a reduction in power produced by the engine. If not corrected by the pilot this may lead to rough running of the engine and engine failure.

When operating in conditions conducive to carburettor icing, pilots should use carburettor heat to prevent and remove ice build-up. After selecting carburettor heat, engine performance may deteriorate further as the ice is melted before engine performance returns to normal. This may take up to 30 seconds.

Instructor comment

The instructor of IPO provided the following comments:

On the two circuits prior to the engine failure, the student selected carburettor heat on prior to turning onto the base leg of the circuit with no indications of carburettor icing.

After the second go-around, the student joined a shortened downwind. The time period when the carburettor heat was selected off, where the carburettor ice appeared to form was very short and occurred at a very high power setting.

Safety action

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

Aircraft operator

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

- The operator has increased instructor and student awareness of carburettor icing probability and symptoms for early detection. The operator has issued all instructors and students with a copy of the CASA article *Ice kills*.

- The operator will review relevant company briefs to include carburettor ice probability and prevention.
- The operator has recommended the company operations manual be reviewed to mitigate against flying outside of gliding distance to the runway during circuit training.

Safety message

This incident highlights the insidious nature of carburettor icing and the speed with which carburettor icing can occur in favourable environmental conditions. The incident also reinforces the need for pilots to be aware of the risk of carburettor icing at all times during the operation of aircraft fitted with a carburettor.

- The ATSB article *Melting moments: Understanding carburettor icing* provides valuable information to assist pilots in understanding and preventing carburettor icing.
- The article *Piston engine icing* produced by the European Strategic Safety Initiative provides in-depth information to assist pilots in identifying and managing carburettor icing.

General details

Occurrence details

Date and time:	16 June 2016 – 1114 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Engine failure or malfunction	
Location:	Mangalore Airport, Victoria	
	Latitude: 36° 53.30' S	Longitude: 145° 11.05' E

Aircraft details

Manufacturer and model:	Piper Aircraft Corporation PA-28	
Registration:	VH-IPO	
Serial number:	28-7816627	
Type of operation:	Flying training - Training Dual	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Precautionary landing involving Cessna 150, VH-TDZ, and Cessna 152, VH-KTL

What happened

On the morning of 3 July 2016, a Cessna 150M aircraft, registered VH-TDZ (TDZ), and a Cessna 152 aircraft, registered VH-KTL (KTL), departed from the Exmouth aircraft landing area (ALA), Western Australia, to conduct whale shark spotting on the western side of the Exmouth peninsula. Each aircraft had only the pilot on board.

The east and west coasts of the Exmouth peninsula are separated by ranges with peaks of about 600 to 1,100 ft. The weather forecast for Learmonth Airport, located about 10 NM south of the Exmouth ALA,[1] included easterly winds and TEMPO[2] periods for reduced visibility and a cloud base of 800 ft. However, both aircraft were able to depart directly to the west from Exmouth ALA and track over the ranges in visual meteorological conditions (VMC).[3]

On the western side of the peninsula, they were joined by two other aircraft, also engaged in whale shark spotting. The four pilots set up vertical and horizontal separation between their aircraft for their whale shark spotting.

At about 1045 Western Standard Time (WST), the pilot of the aircraft operating to the north decided to return to Exmouth due to deteriorating weather approaching from the north. The other three pilots decided to continue whale shark spotting[4] and reported that the weather conditions improved temporarily after the first aircraft departed. However, about one hour later, the cloud base lowered and visibility reduced on the western side of the peninsula, and the three pilots collectively agreed to return to Exmouth.

As the deteriorating weather was approaching from the north, the pilots decided to track to the south and then east across the coastline and peninsula at an altitude of about 1,000 ft. As the aircraft flew eastward, the cloud base and visibility continued to lower. The pilot of TDZ assessed it was unsuitable to continue in that direction and the three aircraft turned around and headed west back to the coastline.

The first aircraft then returned to Exmouth ALA by flying over water around the north of the peninsula below the cloud base. The pilots of KTL and TDZ considered the weather conditions to the north to be unsuitable and therefore they decided to orbit overhead Yardie Creek Road (Figure 1) near the western coast of the peninsula to see if the weather conditions would improve. The pilot of KTL identified a straight section of the road, orientated north-south, as suitable for a precautionary landing. The pilot of TDZ also orbited over the road below the cloud base of about 500 ft.

While orbiting overhead the road, the pilots assessed the weather conditions to the north were continuing to deteriorate and unsuitable to attempt a return flight northward, either around the peninsula or to the Yardie homestead airstrip, located at the north-western end of the peninsula

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1 Learmonth Airport is the closest airport to Exmouth ALA with a dedicated weather forecast service.

2 A temporary deterioration in the forecast weather conditions, during which significant variation in prevailing conditions are expected to last for periods of between 30 and 60 minutes.

3 Visual Meteorological Conditions is an aviation flight category in which Visual Flight Rules (VFR) flight is permitted – that is, conditions in which pilots have sufficient visibility to fly the aircraft maintaining visual separation from terrain and other aircraft.

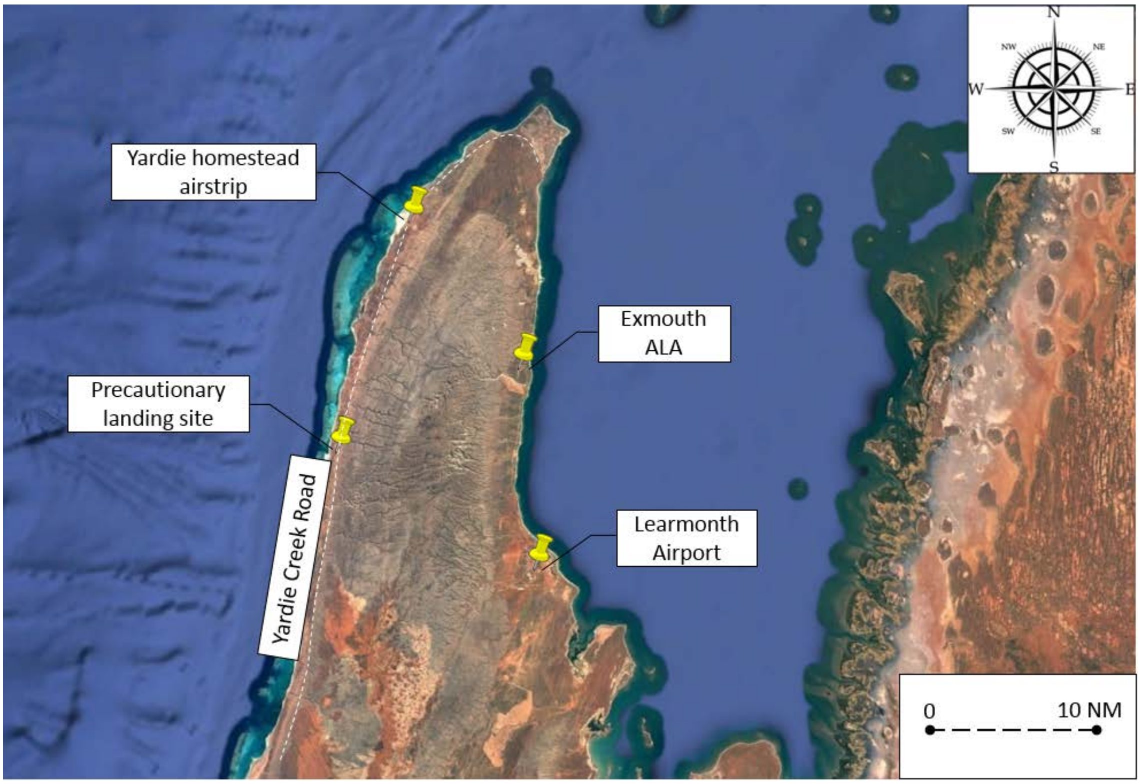
4 Several days of whale shark spotting were lost due to inclement weather prior to the day of the incident. The pilots were also aware that the weather conditions forecast for the next few days would unsuitable for further whale shark spotting.

(Figure 1). After about 5–6 orbits, the pilot of KTL assessed that the weather was deteriorating, and after confirming that the road was clear of vehicles and other obstacles, conducted a landing on the road in a southerly direction. The pilot of KTL parked their aircraft at the southern end of the straight section of road and attempted to block the road while waiting for the pilot of TDZ to land.

The pilot of TDZ conducted three approaches to the road and performed go-arounds from the first two approaches due to vehicles on the road and the strength of the easterly wind. At about 1215, on their third approach, the pilot of TDZ landed the aircraft on the road. Both aircraft were subsequently moved clear of the road to allow vehicles to pass. The aircraft did not sustain any damage and the pilots were not injured.

Local police attended the scene and blocked the section of road when the pilots were ready to depart. The pilots inspected their aircraft, and after the weather conditions improved, they took off from the road and returned to Exmouth ALA.

Figure 1: Exmouth peninsula with key locations



Source: Google earth, annotated by ATSB

Visual Meteorological Conditions (VMC)

The whale shark spotting flights were local flights in Class G airspace in accordance with VMC procedures. This class of airspace required the following weather conditions when operating an aeroplane below 3,000 ft above mean sea level or below 1,000 ft above ground level, whichever was higher:

- visibility of 5,000 m
- clear of cloud and in sight of ground or water.

The pilots reported that at times when there is low cloud, which prevents them crossing the ranges in VMC, they fly coastal around the peninsula below the cloud base.

Weather forecast

The pilots' flight planning included reviewing the Aerodrome Forecast (TAF)[5] for Learmonth Airport and the area forecast (ARFOR).[6] Learmonth was the closest airport to Exmouth ALA with a dedicated weather forecast service and the pilots used the TAF as an indication of local weather conditions for the eastern side of the peninsula. The pilots reported noting the TEMPO periods for reduced cloud base to 800 ft on the TAF (Figure 2).

The highlighted section of Figure 2 indicates the weather may deteriorate for periods between 30 and 60 minutes between 3 July 0800 WST and 4 July 0800 WST for visibility reduced to 3,000 m in rain with a broken[7] cloud base at 800 ft.

Figure 2: Learmonth TAF

```
TAF AMD YPLM 022233Z 0300/0324
10010KT 9999 -RA BKN020
FM031600 10010KT 9999 -RA BKN010
TEMPO 0300/0324 3000 RA BKN008
RMK
T 19 22 22 21 Q 1016 1017 1014 1014
```

Source: Bureau of Meteorology, annotated by ATSB

The ARFOR indicated rain and low cloud in the area with the possibility of heavy rain offshore. The minimum visibility forecast was 7 km in light rain, reducing to 1,000 m in heavy rain, and the minimum cloud base forecast was broken between 800 ft and 2,000 ft. The forecasted wind was easterly at the surface, but was between north-east and north-west from 1,000 to 10,000 ft.

Actual weather

At the time of their departure, the pilots noted that the cloud base was 'well clear' of the tops of the ranges, which permitted a VMC track to the west from Exmouth ALA. At about 1145, the pilots noted low cloud approaching from the north, which led to their decision to attempt to track south and east across the peninsula.

Figure 3 depicts the rainfall detected by the Learmonth weather radar at 1210, about the time that the pilots conducted their precautionary landing on the west coast.

The pilot of KTL reported that the cloud base was 'about 300 ft' and visibility was 'about 4 km', but reduced to 'about 3 km to the north' at the time of their precautionary landing. The pilot of TDZ, which landed after KTL, reported that the cloud base was 'about 500 ft' and visibility was 'about 2-3 NM' at the time of their precautionary landing.

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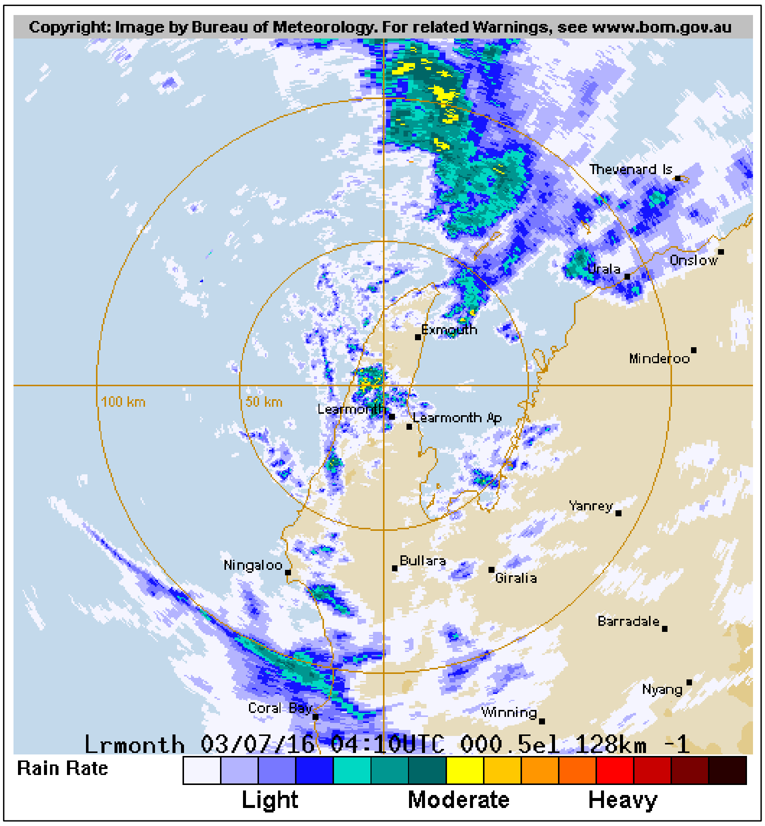
5 Aerodrome Forecasts are a statement of meteorological conditions expected for a specific period of time, in the airspace within a radius of 5 NM (9 km) of the aerodrome.

6 An area forecast issued for the purposes of providing aviation weather forecasts to pilots. Australia is subdivided into a number of forecast areas.

7 Cloud cover is normally reported using expressions that denote the extent of the cover. The expression broken (BKN) indicates that more than half to almost all the sky was covered.

Figure 3: Weather radar image depicting rainfall 1210 WST



Source: Bureau of Meteorology

ATSB comment

When the weather deteriorated, the pilots initially attempted to return to Exmouth by tracking across the southern end of the Exmouth peninsula. The deteriorating weather conditions were driven by the northerly winds, which meant that the northern end of the peninsula, including the Yardie homestead airstrip, would be affected by the low cloud and reduced visibility before it reached the southern end of the peninsula.

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 of VH-TDZ

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

Operations manual amendment

The whale shark spotting section of the operations manual was amended to highlight the following:

> *Pilots are to use their judgement to make an early decision on deteriorating weather conditions. The Yardie Creek Homestead Caravan Park airstrip is to be used as the alternate landing site during periods of rain showers or low cloud and pilots are not to attempt to fly over the range in low cloud.*

Operator of VH-KTL

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

Operations manual amendment

> Company pilots conducting aerial work operations are to maintain an awareness of meteorological conditions. In the event of deteriorating conditions due to cloud or rain, pilots will make an early decision and depart from the area that is potentially affected by loss of VMC. Pilots are to have an alternate plan in the event of deteriorating weather.

Safety message

This incident highlights the need for pilots to interpret the weather forecast within the context of their planned operation. In this case the ARFOR indicated low cloud, rain and visibility below VMC could approach their operating area from a northerly direction and affect the pilots' poor-weather exit strategy. Fortunately, during their attempt to cross the peninsula, the pilots had a return path to the coast open and were eventually able to safely land on a road and avoid entering instrument meteorological conditions.[8] There are several key factors for a VFR pilot to consider to avoid inadvertently entering IMC, which include:

- thorough pre-flight planning
- having alternate plans in the event of deteriorating weather
- making timely decisions to turn back or divert.

An explanation of what the ARFOR message structure means for pilots is available from the Bureau of Meteorology's *Aviation Weather Products: Area Forecasts*.

Further information about pre-flight planning considerations is available from the Civil Aviation Safety Authority's *Visual Flight Rules Guide*.

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

General details

Occurrence details

Date and time:	3 July 2016 – 1215 WST	
Occurrence category:	Incident	
Primary occurrence type:	Weather - other	
Location:	22 km WSW of Exmouth ALA, Western Australia	
	Latitude: 22° 06.97’ S	Longitude: 113° 54.15’ E

Aircraft details – VH-TDZ

Manufacturer and model:	Cessna Aircraft Company 150	
Registration:	VH-TDZ	
Serial number:	15075794	
Type of operation:	Aerial Work - Other	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Aircraft details – VH-KTL

Manufacturer and model:	Cessna Aircraft Company 152	
Registration:	VH-KTL	
Serial number:	15285665	
Type of operation:	Aerial Work - Other	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Nil	

Helicopters

Controlled flight into terrain involving Agusta A109, VH-XPB

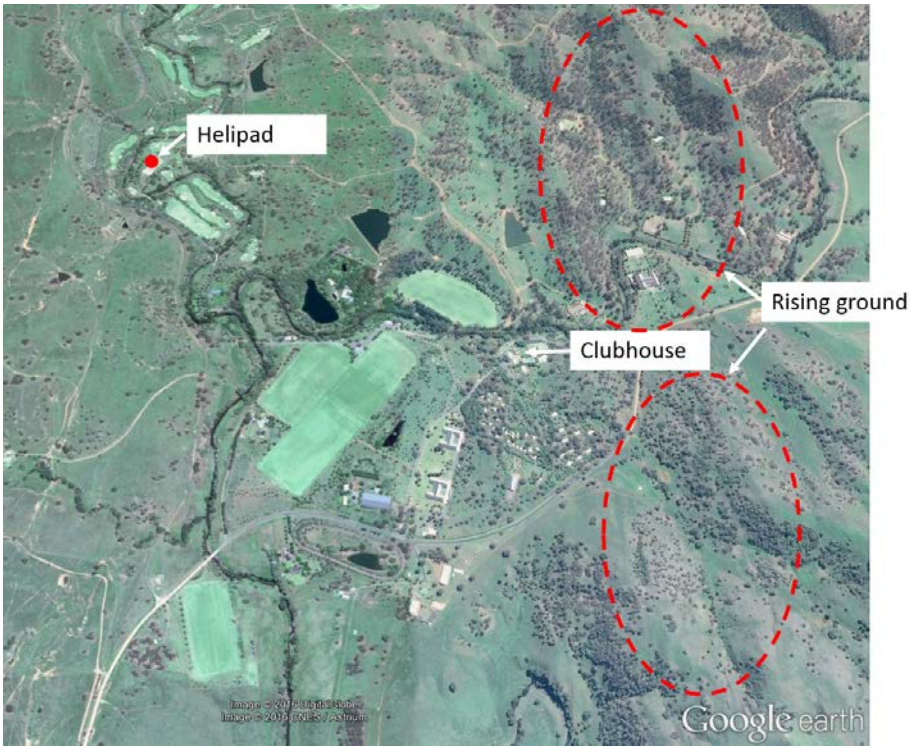
What happened

On 10 June 2016, the pilot of an Agusta S.P.A A109S helicopter, registered VH-XPB, prepared to conduct a private flight under the instrument flight rules[1] from Sydney Airport to Ellerston, New South Wales (NSW), with three passengers on board. As the planned arrival time at Ellerston was after dark, the pilot contacted ground personnel at Ellerston before departure, who advised there was lighting at the helicopter landing site (HLS). The pilot also entered the coordinates of the HLS into the helicopter's global positioning system (GPS). The elevation of the HLS was 1,720 ft above mean sea level (AMSL).

The helicopter departed Sydney at about 1738 Eastern Standard Time (EST). During the cruise at 8,000 ft AMSL, the helicopter entered cloud, with the cloud base at about 4,500 ft. When about 10 NM from Ellerston, the pilot commenced a descent to the calculated lowest safe altitude[2] of 6,500 ft.

When about 3 NM from Ellerston, with the property in sight, the pilot commenced a descent to 3,500 ft, to ensure adequate terrain clearance for arrival overhead the GPS position of the helipad (Figure 1). During the descent, the pilot sighted the lights from the buildings at Ellerston and visually confirmed they were at the intended location.

Figure 1: Ellerston property



Source: Google earth – annotated by ATSB

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1 Instrument flight rules 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, while controlling the aircraft solely by reference to instruments. IFR-capable aircraft have greater equipment and maintenance requirements.

2 The lowest altitude which will provide safe terrain clearance at a given place.

At about 1838, the helicopter arrived overhead the GPS position for the helipad. The pilot sighted a red beacon, but as they had expected to see the illuminated hangar and helipad, became unsure of the location of the HLS. The pilot reported that they then descended to about 2,500–3,000 ft and tracked to the west and north-west towards other lit buildings and then to the east back over the red light, but did not see any illumination indicative of a HLS. The pilot then elected to track towards the buildings of the homestead and descend to verify their exact location.

At about 1841, the helicopter descended to 2,286 ft (according to recorded data) in the vicinity of the Ellerston clubhouse and nearby buildings which the pilot reported were all well illuminated and visible. The elevation of the terrain at that point was 1,770 ft with rising ground to the north and south-east up to 2,250 ft (Figure 1). The pilot reported that they were then sure of their exact location, and assessed that the red light must be on the hangar next to the HLS.

The pilot then commenced a right turn to position for an approach from 2 NM to the north-east of the HLS. At about 1842, as the aircraft was positioning for the approach, the pilot received a 'landing gear' warning from the radio altimeter. This warning is generated whenever the helicopter is below 200 ft above ground level (AGL) without the landing gear extended. The pilot immediately raised full collective and commenced a climb to 4,000 ft AMSL tracking towards the south. A low rotor RPM occurrence was recorded on the aircraft computer at 1842, indicative of a rapid raising of the collective.[3]

After climbing to 4,000 ft, the pilot turned to track towards the red light from the south-southwest, and saw a flashing bright torch light near the red light indicating the HLS. The pilot then positioned the helicopter to the north-east of the HLS and commenced an approach. During the approach, ground personnel shone car headlights from the sealed area, which confirmed to the pilot that the helicopter was approaching the helipad. At about 50 ft AGL, the pilot was able to identify ground features at the helipad and continued with the landing.

After landing, the passengers disembarked and the pilot refuelled the helicopter. The pilot then conducted a ferry flight to Camden Airport, NSW. After arriving in Camden, the helicopter was pushed into a well-lit hangar, at which stage damage to the helicopter was detected. It was apparent that the helicopter had struck a tree branch, causing damage to the right side landing lights, horizontal stabiliser, vertical fin and rotating beacon (Figure 2). It was unclear exactly when the helicopter had struck a tree.

Figure 2: Damage to right landing light of VH-XPB

Source: Helicopter operator

3 A primary helicopter flight control that simultaneously affects the pitch of all blades of a lifting rotor. Collective input is the main control for vertical velocity. Raising or lowering the collective lever increases or decreases the main rotor lift, which increases or decreases main rotor drag. The collective lever is also connected to the engine anticipators, which respond to raising or lowering of the collective by increasing or decreasing engine power to compensate for the changes in main rotor drag and govern the main rotor speed.

Pilot comments

After overflying the buildings and positively establishing the helicopter's position, the pilot turned right to track north. A line of hills ran north-south from that area. The pilot was then attempting to maintain about 500 ft AGL and when the 200 ft radio altimeter 'landing gear' warning sounded, the helicopter was either descending (without the pilot realising) or maintaining altitude, but heading towards rising ground.

The pilot assessed that the helicopter probably struck a branch when the 200 ft warning sounded. The pilot did not hear or feel the collision, but at the time the warning sounded, the pilot rapidly raised full collective and their workload was high. If the collision with the tree branch had occurred later during the approach to the helipad, the pilot thought they would have heard or felt it due to lower airspeed and engine power settings. The pilot was not aware of having struck anything and no damage was detected during refuelling at Ellerston.

The pilot had landed at Ellerston three times previously in daylight but had not been there at night. After speaking to ground personnel prior to the flight, the pilot was expecting the sealed area and helipad to be illuminated. When there was no illumination visible from above, in the vicinity of the helipad, the pilot became confused as they could see the red light but not the helipad. In response, they orbited to confirm their position and then to determine where the helipad was in relation to that position. They were then trying to get visual reference with the landing site and remain at a safe height above the terrain and any obstacles.

Due to the overcast cloud, there was no celestial illumination, and as the area was surrounded by high ground, it was a black hole. In that situation, the pilot's attention was split between looking outside to establish their position relative to the landing area, and inside at the instruments to maintain altitude and speed.

On a dark night, pilots need to apply greater safety margins such as use of the autopilot to reduce pilot workload, and maintaining a greater height above terrain until the landing site has been positively identified and an approach commenced.

Aircraft satellite tracking data

The helicopter was fitted with a satellite tracking system which recorded the time and the helicopter's position, height and speed, at 2-minute intervals. The 200 ft warning occurred between two of the recorded points, so the exact position and altitude of the helicopter at that time was not recorded.

Operator report

The helicopter operator conducted an investigation and found the following factors contributed to the incident:

- It was assumed by the company that the pilot was familiar with the layout and positioning of the Ellerston village and helipad because they had operated there on multiple occasions during daylight in the same aircraft, and they had discussed lighting arrangements with ground staff prior to the flight.
- The helipad did not have the appropriate edge lighting to identify it as a HLS for night operations.
- After flying overhead and realising the need to orbit to identify the helipad, the pilot should have nominated a vertical limit of 3,500 ft and a horizontal limit of 2 or 3 NM to prevent inadvertent controlled flight into terrain. A descending turn while scanning between ground lights and instruments in a pitch-black environment creates a very high workload. Planning the descent with absolute limits is critical to maintaining situational awareness. The use of autopilot in this situation can also aid in reducing workload while scanning outside.

- Although the pilot was highly experienced and current with regard to regulatory requirements, lack of training in the conduct of 'black hole' approaches (recognised as a particularly demanding exercise) was identified as a factor.

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 safety action in response to this occurrence.

Helicopter operator

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

- Introduction of night, black hole approach training and controlled flight into terrain avoidance technique training for all pilots who conduct night and IFR operations. This is to include both inflight and simulator training.
- No company pilot will be authorised to fly into the Ellerston helipad at night without specific familiarisation training from the local pilot.
- It is recommended that the Ellerston HLS be assessed against standard HLS lighting requirements for any future night operations.
- All private helipads with potential for night operations are to be risk assessed and documented procedures produced.
- Adjustment of the radio altimeter warning decision height for the A109 is limited to the standard 200 ft and 150 ft alerts. A variable decision height warning device is to be investigated.
- The company will increase the reporting rate on the satellite-tracking device from 2-minute to 1-minute intervals.

Safety message

The ATSB SafetyWatch highlights the broad safety concerns that come out of our investigation findings and from the occurrence data reported to us by industry. One such concern is flying with reduced visual cues.

The ATSB publication *Avoidable Accidents No. 7 - Visual flight at night accidents: What you can't see can still hurt you* explains how suitable strategies can significantly reduce the risks of flying visually at night.

The extra risks inherent in visual flight at night are from reduced visual cues, and the increased likelihood of perceptual illusions and consequent risk of spatial disorientation. Situational awareness with respect to the relative position of terrain and obstacles is fundamentally important during the conduct of limited visibility operations.

General details

Occurrence details

Date and time:	10 June 2016 – 1842 EST	
Occurrence category:	Serious incident	
Primary occurrence type:	Controlled flight into terrain	
Location:	Ellerston, New South Wales	
	Latitude: 31° 49.00' S	Longitude: 151° 18.00' E

Aircraft details

Manufacturer and model:	Agusta S.P.A. A109	
Registration:	VH-XPB	
Serial number:	22025	
Type of operation:	Private – Pleasure/Travel	
Persons on board:	Crew – 1	Passengers – 3
Injuries:	Crew – 0	Passengers – 0
Aircraft damage:	Minor	

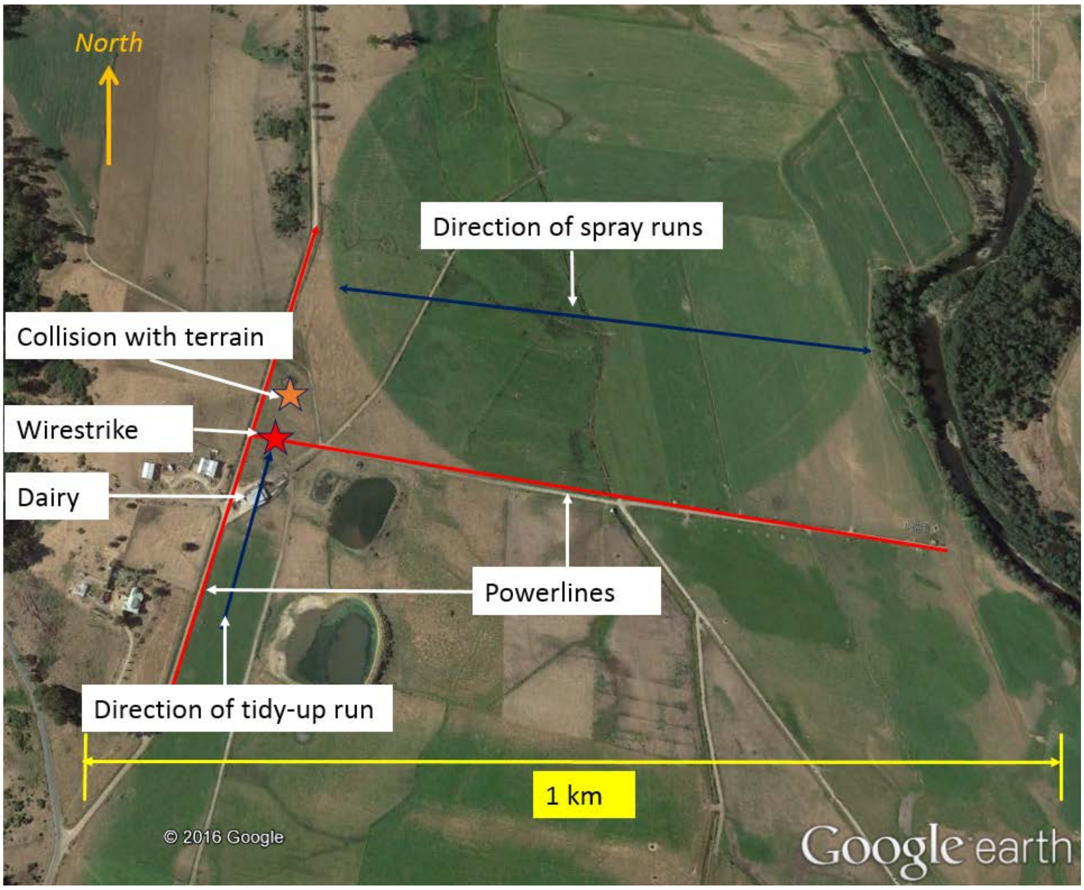
Wirestrike and collision with terrain involving Schweizer 269C, VH-NTZ

What happened

On 20 July 2016, the pilot of a Schweizer 269C helicopter, registered VH-NTZ, conducted aerial spraying operations near Deloraine, Tasmania.

The pilot completed spraying one area, and prior to commencing spraying another, overflew it to assess the site. During that inspection, the pilot sighted two sets of powerlines, one running approximately north-south, and the other branching off to the east. Based on the location of the powerlines and the wind, which was a light northerly, the pilot elected to spray the paddock in an east-west direction (Figure 1). The helicopter was operating north of the powerline running east-west, and in each run, was overflying and remaining clear of the powerlines at the western end of the paddock.

Figure 1: Area of operations showing powerlines



Source: Pilot

At about 1230 Eastern Standard Time (EST), after completing two spray loads, the pilot tracked south over the powerline and turned to conduct a tidy-up run to the north along the road and powerlines running north-south.

After overflying a dairy building, the helicopter descended as the pilot intended to commence spraying. However, the helicopter struck the powerlines running east-west and subsequently collided with terrain.

The pilot, who was the sole occupant of the helicopter, sustained serious injuries and the helicopter was destroyed (Figure 2).

Figure 2: Accident site

Source: Tasmania Police

Pilot comments

Prior to commencing the day's operations, the pilot had obtained a map of the area and identified hazards including the powerlines. During the aerial inspection of the property prior to commencing spraying, the pilot had sighted those hazards.

The pilot commented that in the tidy-up run they should have been thinking 'over the dairy and over the powerlines then descend', but had momentarily forgotten about the powerlines and descended after passing over the dairy. Usually they overflew the whole paddock again to check for hazards before commencing a tidy-up run, but had omitted to do it on this occasion.

The pilot was wearing a helmet at the time of the accident. The helmet was found some distance from the wreckage and was badly damaged.

Safety message

ATSB research indicates that in 63 per cent of reported wirestrike incidents, pilots were aware of the position of the wire before they struck it.

The Aerial Application Association of Australia (AAAA) suggests a way to keep focus is to ask yourself:

- Where is the wire now?
- What do I do about it?
- Where am I in the paddock?

For further risk management strategies for agricultural operations, refer to the AAAA *Aerial application pilots manual*.

The ATSB publication *Avoidable Accidents No. 2 – Wirestrikes involving known wires: A manageable aerial agricultural hazard*, explains strategies to help minimise the risk of striking wires while flying.

US military research[1] analysed helicopter accidents that were at least partially survivable. It found that occupants not wearing a protective helmet were significantly more likely to sustain severe and fatal head injuries. The US National Transportation Safety Board (NTSB) also acknowledged that the use of head protection can reduce the risk of injury and death. The NTSB issued Safety Recommendation A-88-009, recommending that crewmembers of emergency medical services helicopters wear protective equipment including helmets.

The ATSB investigation report (AO-2014-058) into an accident involving a Robinson R22 helicopter where the pilot sustained a serious head injury, reminded pilots and operators to consider the benefit of occupants wearing helmets to reduce the risk of head injury.

General details

Occurrence details

Date and time:	20 July 2016 – 1230 EST	
Occurrence category:	Accident	
Primary occurrence type:	Wirestrike	
Location:	45 km SE of Devonport aerodrome (Deloraine), Tasmania	
	Latitude: 41° 34.02' S	Longitude: 146° 32.22' E

Helicopter details

Manufacturer and model:	Schweizer Aircraft Corporation 269C	
Registration:	VH-NTZ	
Serial number:	S1405	
Type of operation:	Aerial Work - Aerial Agriculture	
Persons on board:	Crew – 1	Passengers – 0
Injuries:	Crew – 1 (Serious)	Passengers – 0
Aircraft damage:	Destroyed	

1 Crowley, J.S. (1991) Should Helicopter Frequent Flyers Wear Head Protection? A Study of Helmet Effectiveness. *Journal of Occupational and Environmental Medicine, 33(7),* 766-769.

Hot Air Balloons

Fire prior to passenger disembarkation involving Kavanagh Balloons, B-400, VH-WNV

What happened

At about 0725 Eastern Standard Time (EST) on the morning of 24 April 2016, the pilot of a Kavanagh Balloons B-400, registered VH-WNV (WNV), prepared to land at Rothbury near Cessnock, New South Wales (Figure 1). On board the scenic flight were the pilot and 16 passengers. The balloon was one of a number of balloons conducting a similar scenic flight that morning.

The pilot had selected a landing site, and informed the ground crew by radio, but the light wind carried WNV, and the other balloons in the group, a little further past this site. The pilot in WNV (and the other balloon pilots) then selected a nearby paddock for landing, and updated the ground crew accordingly. The pilot lined the balloon up to land, but then noticed a small dam along the intended landing path. The pilot manoeuvred the balloon over the dam before turning off the burners, and making a gentle landing.

Figure 1: VH-WNV landing area (green circle)

Source: Airservices Australia: Extract of Sydney World Aeronautical Chart, annotated by ATSB

The manoeuvring over the dam resulted in the balloon being a little closer to the tree line than ideal (Figure 2). Mindful that the ground crew had to pack up the 400,000 cubic foot balloon once the passengers has disembarked, the pilot advised them that they would move the balloon back about 10m further from the trees. To assist with this process, and make the balloon more buoyant, the pilot checked the neck of balloon was still sufficiently open, and then turned on the pilot light of one of the two burners.

Moments later, the pilot again checked the neck of the balloon and noticed the gentle wind had blown part of the deflating balloon back on itself and there was black smoke emanating from this area. The pilot then observed that some of the fabric had melted and had begun to drip onto the occupants of the basket. The pilot quickly re-directed the ground crew from the task of pulling the top of the balloon down, to assisting the passengers disembark and move away to a safe area.

To avoid any potential of the balloon becoming aloft during the disembarkation process, the pilot pulled the smart vent[1] to rapidly release air. The pilot reported it was difficult to assess the extent of the fire from the basket, but they were aware that the balloon envelope 'sliding' on itself was adding more fabric as 'fuel' to the fire.

The balloon envelope deflated and landed next to the basket. The pilot (still on board) and the ground crew, after ensuring the passengers were safe, discharged fire extinguishers. Within a few minutes, the crew were able to spread the balloon envelope out and extinguish the fire.

During the emergency disembarkation, two of the passengers received minor burn injuries. The lower section of balloon envelope was substantially damaged.

Figure 2: Kavanagh Balloons B-400, VH-WNV at Rothbury

Source: Pilot

Pilot comments

The pilot had logged over 1,330 flying hours, with about 350 hours on the Kavanagh Balloons B-400.

In hindsight, the pilot advised that the decision to move the balloon back 10 m to assist the ground crew with the collapse and pack-up of such a large balloon was not the correct one. Other balloons landing nearby did not attempt to move their balloons away from the tree line.

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1 The smart vent is a vent at the top of the balloon allowing air to rapidly escape (opens in less than three seconds).

Safety message

This occurrence highlights how quickly events may change. The simple decision by an experienced pilot to move the balloon back 10 m from the tree line to assist the ground crew inadvertently led to a fire.

The Federal Aviation Administrations' (FAA) comprehensive *Balloon Flying Handbook (2008)* covers all aspects of balloon flying including aeronautical decision-making. Aeronautical decision-making is a systematic approach to the mental process used by pilots to determine the best course of action in response to a given set of circumstances. It builds on the foundation of conventional decision-making, but enhances the process to decrease the probability of pilot error.

As almost all ballooning operations are conducted as single-pilot operations, ballooning uses a variant of crew resource management, known as single-pilot resource management. This integrates:

- human resources
- situational awareness
- decision-making process
- risk management
- training.

One way in which the risk management decision path can be framed is through the perceive-process-perform model, which offers a structured way to manage risk.

- Perceive the hazard by looking at:
  – pilot experience, currency, condition
  – aircraft performance, fuel
  – environment (weather, terrain)
  – external factors.
- Process the risk level by considering:
  – consequences posed by each hazard
  – alternatives that eliminate hazards
  – reality (avoid wishful thinking)
  – external factors ('get-home-itus').
- Perform risk management:
  – transfer – can someone be consulted?
  – eliminate – can hazards be removed
  – accept – do benefits outweigh risk?
  – mitigate – can the risk be reduced?

Other decision-making models are also covered in the manual.

General details

Occurrence details

Date and time:	24 April 2016 – 0725 EST	
Occurrence category:	Accident	
Primary occurrence type:	Fire	
Location:	Near Cessnock Airport (Rothbury)	
	Latitude: 32° 41.58' S	Longitude: 151° 20.08' E

VH-WNV

Manufacturer and model:	Kavanagh Balloons B-400	
Registration:	VH-WNV	
Serial number:	B400-482	
Type of operation:	Charter - passenger	
Persons on board:	Crew – 1	Passengers – 16
Injuries:	Crew – 0	Passengers – 2 (Minor injuries)
Aircraft damage:	Substantial	

Australian Transport Safety Bureau

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

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

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

Purpose of safety investigations

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

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

About this Bulletin

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

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

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

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

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

Conducting these Short investigations has a number of benefits:

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

Australian Transport Safety Bureau

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Investigation

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