Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation
AO-2010-023
Final

Collision with terrain
43 km east of Perth Airport, WA
28 March 2010
VH-KDS, Piper PA-30-160B Twin Comanche

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Abstract

At 0826 Western Standard Time on 28 March 2010, a Piper Aircraft Corp. PA-30 Twin Comanche aircraft, registered VH-KDS, departed Jandakot Airport, Western Australia for a private flight under the visual flight rules (VFR). On board were two qualified pilots, both of whom were endorsed on the aircraft type. No details of the flight were submitted to Air Traffic Services nor left with any other person. At 1815, following the failure of the aircraft to return to Jandakot, the Australian Rescue Coordination Centre was notified and a search was initiated to locate the aircraft.

Following examination of radar data, the aircraft was located the following morning by the crew of a search and rescue (SAR) helicopter. Upon landing, the helicopter crew established that the two occupants had sustained fatal injuries.

Analysis of data recorded by onboard Global Positioning System equipment identified that while maintaining about 3,500 ft above mean sea level, the speed of the aircraft steadily decreased followed by a steep descent that continued to ground level.

Examination of the aircraft identified that the propeller of the left engine was feathered prior to impact; however, no evidence of a defect or other circumstance that would have necessitated feathering of the propeller was identified.

The investigation identified that the circumstances of the accident were consistent with a loss of control due to sufficient airspeed not being maintained. In addition, the investigation found that the lack of flight details available for the search and rescue authorities and the non-activation of the portable emergency locator transmitter hampered the SAR response.

THE 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.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Risk level: The ATSB's assessment of the risk level associated with a safety issue is noted in the Findings section of the investigation report. It reflects the risk level as it existed at the time of the occurrence. That risk level may subsequently have been reduced as a result of safety actions taken by individuals or organisations during the course of an investigation.

Safety issues are broadly classified in terms of their level of risk as follows:

- **Critical** safety issue: associated with an intolerable level of risk and generally leading to the immediate issue of a safety recommendation unless corrective safety action has already been taken.
- **Significant** safety issue: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable. The ATSB may issue a safety recommendation or a safety advisory notice if it assesses that further safety action may be practicable.
- **Minor** safety issue: associated with a broadly acceptable level of risk, although the ATSB may sometimes issue a safety advisory notice.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency in response to a safety issue.

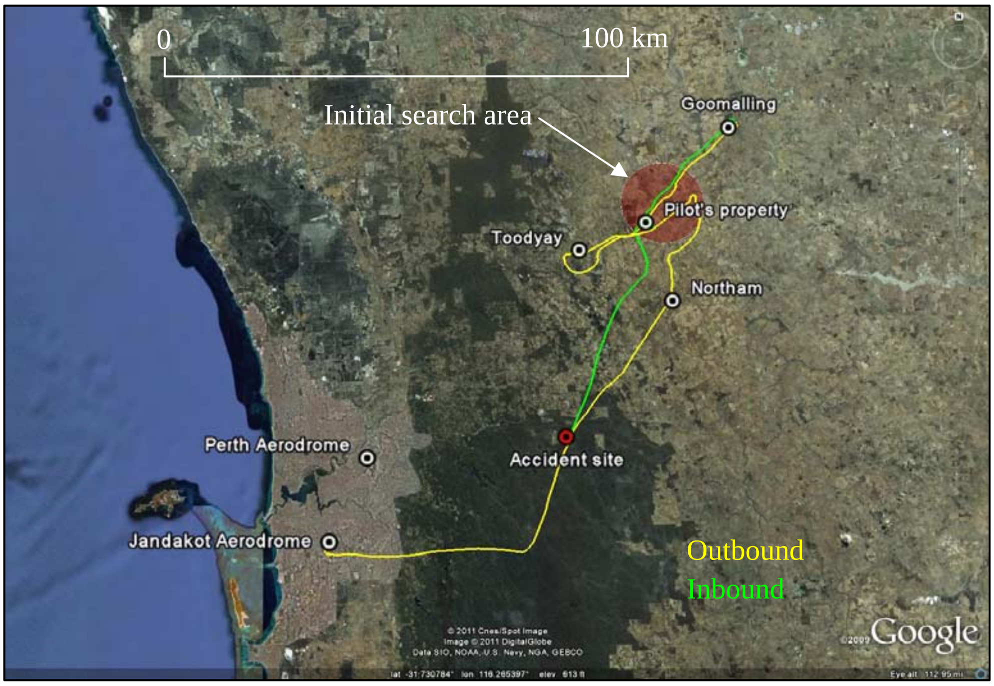
FACTUAL INFORMATION

History of the flight

At 0826 Western Standard Time[1] on 28 March 2010, a Piper Aircraft Corp. PA-30 Twin Comanche aircraft, registered VH-KDS, departed Jandakot Airport, Western Australia for a private flight under the visual flight rules (VFR). On board were two qualified pilots, both of whom were endorsed on the aircraft type. No details of the flight were submitted to Air Traffic Services (ATS) nor left with any other person and there was no requirement to do so (see the section titled *Flight notification requirements*). At 1815, following the failure of the aircraft to return to Jandakot, the Australian Rescue Coordination Centre (RCC) was notified by an associate of the aircraft owner and a search was initiated to locate the aircraft.

RCC enquiries established that no emergency satellite signals (see the section titled *Emergency locator transmitters*) or radio calls had been received from the aircraft. An examination of the recorded radar information, established that, following departure from Jandakot, the aircraft proceeded north-east to the vicinity of a property owned by one of the pilots (Figure 1). The data indicated that the aircraft conducted operations between the property and Toodyay township prior to the loss of radar identification about 5 km north-east of the pilot's property, as the aircraft descended below 2,100 ft above mean sea level (AMSL).[2]

Figure 1: Flightpath



1 The 24-hour clock is used in this report to describe the local time of day, Western Standard Time (WST), as particular events occurred. Western Standard Time was Coordinated Universal Time (UTC) + 8 hours.

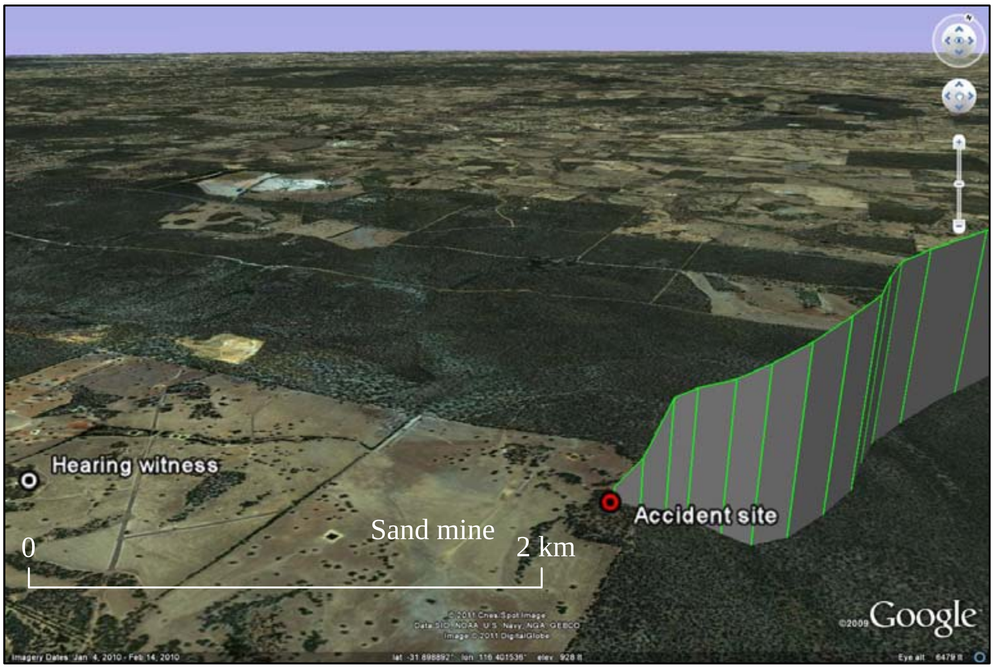
2 Consistent with the lower limit of radar coverage in the area.

At 0110 on 29 March 2010, a search and rescue (SAR) helicopter departed from Jandakot Airport to conduct a search in the vicinity of the last radar position. The helicopter crew completed a search of the area at about 0230 without locating the aircraft.

At 0618 the RCC was notified that further analysis of the radar data had re-identified what was believed to be the aircraft proceeding south-west from the vicinity of Northam township (Figure 1). The radar data indicated that, at about 38 km from Northam, the aircraft commenced a steep descent before radar identification was again lost. In response, another aerial search commenced in the vicinity of this last radar position and, at 0814, the crew of a SAR helicopter sighted the aircraft wreckage. Upon landing, the helicopter crew established that the two occupants had received fatal injuries.

Information on the aircraft's flight path was recovered from a Global Positioning System (GPS) unit onboard the aircraft. That information, which included position, groundspeed and altitude, indicated that following departure from Jandakot Airport, the aircraft tracked to the north via a VFR route to the east of Perth Airport (Figure 1). The aircraft overflew Northam township prior to conducting operations between Toodyay and Goomalling township, before tracking to the south via the same VFR route towards Jandakot. The GPS data indicated that, at 0948 on 28 March 2010, the aircraft commenced a steep descent from about 3,500 ft that continued to ground level (Figure 2). The GPS data also indicated that in the minute before the descent, the groundspeed steadily decreased while the aircraft maintained an approximately constant track and altitude (see the section titled *Examination of recovered components*).

Figure 2: Final flight segment



On the morning of the accident a witness, who was located about 2 km from the accident site, recalled hearing an aircraft engine that was approaching from the north 'splutter' once or twice before resuming normal operation. A short time later the engine revolutions were heard to increase significantly followed by a 'thud' or 'boom'. The witness routinely observed aircraft using the VFR route, including previous instances of apparently rough-running engines, and associated the final sound with blasting that routinely occurred at a nearby mine. Following the broadcast of television media reports on the missing aircraft on 29 March 2010, the witness contacted the Police at about 0800 to report those observations.

Personnel information

Both occupants of the aircraft were qualified pilots and had completed initial multiengine endorsement training in the aircraft in late 2008 (Table 1). That training, which consisted of familiarisation with the aircraft type and its associated systems, together with asymmetric control and performance aspects (see the section titled *Asymmetric operation*), satisfied the requirements of a biennial aircraft flight review. The investigation could not determine if any additional proficiency training was conducted by either pilot since completion of their PA-30 endorsement. [3]

Table 1: Pilot qualifications and experience

	Pilot 1	**Pilot 2**
Licence category	Private Pilot Aeroplane Licence (PP(A)L) issued 15 October 1994	PP(A)L issued 28 May 1996
Aircraft endorsements	PA-30/39 class endorsement 28 November 2008 Single-engine aeroplane < 5,700 kg MTOW[4] class endorsement 13 December 1993	PA-30/39 class endorsement 16 October 2008 Single-engine aeroplane < 5,700 kg MTOW class endorsement 21 June 1995
Total flying hours	About 330[5]	719.4[6]
PA-30 flying hours in the preceding 6 months	1.2	3.7
Total PA-30 flying hours	Unknown[7]	32.9[8]
Aviation Medical Certificate category	Class 2 valid to 14 January 2012	Class 2 valid to 4 December 2010
Medical certificate conditions	Distance vision correction to be worn.	Renew by CASA only Reading correction to be available Distance vision correction to be worn. Requirement to fly with a safety pilot.

[3] There was no requirement, beyond an aircraft flight review, for either pilot to conduct any additional flying training or assessment.

[4] Maximum take-off weight.

[5] The pilot's logbook was unable to be located. Flying hours are based on the pilot's stated experience at the time of his last medical assessment conducted on 14 January 2010.

[6] Flying hours based on the pilot's logbook and the accident aircraft flight and maintenance records.

[7] The pilot's endorsement training was completed in 6.9 flying hours.

[8] Including 8.6 flying hours of endorsement training.

Aircraft information

Aircraft specifications

The Twin Comanche, serial number 30-952, was manufactured in the United States (US) in 1966 and first registered in Australia in 1968. The owner of the aircraft, who was not onboard at the time of the accident, had owned the aircraft since 1986.

The Twin Comanche is a light, twin-engined aircraft equipped with feathering propellers (see the section titled *Multiengine aeroplane propellers*) and retractable landing gear (Figure 3). Both engines rotated clockwise[9] as viewed from the pilot's seat and the aircraft was certified to carry six occupants.[10]

Figure 3: VH-KDS

The aircraft was fitted with six fuel tanks comprising four bladder tanks located in the wings and two auxiliary metal wingtip tanks. The bladder tanks consisted of two main fuel tanks, located inboard of the engines, and two auxiliary fuel tanks outboard of the engines. The aircraft was fitted with a fuel selector for each engine that was capable of drawing fuel from either the main or auxiliary tanks.[11] Each fuel selector also incorporated a drain for removing accumulated water from the fuel system. In addition, each wing tank also contained a drain point. The aircraft owner advised that, unlike the wing drain points, the fuel selector drains were not routinely utilised.

During normal operation, each engine used fuel from its respective wing. The fuel system also incorporated an emergency crossfeed system that permitted the

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[9] Later models of the aircraft incorporated a counter-rotating right engine.

[10] The two rear passenger seats were removed at the time of the accident.

[11] Selection of the wingtip auxiliary tank also required activation of an electrically-operated solenoid.

selection of fuel from the opposite wing. In regard to fuel management, the manufacturer's Twin Comanche owner's handbook advised:

> Fuel should be used from the main fuel cells during take-off, landing, climb and descent. Auxiliary fuel and tip tank fuel is to be used in level flight only.
>
> For emergency single engine operation a crossfeed is provided to increase the range...When using fuel from cells on the opposite side of the operating engine, move the fuel selector for the inoperative engine to the main or auxiliary position; then move the fuel selector for the operating engine to the crossfeed position.

An examination of the available refuelling records identified that the aircraft was refuelled with 132 L immediately prior to the departure from Jandakot Airport. Discussion with the refueller established that this quantity of fuel was added to the aircraft's main and wing auxiliary tanks, such that all four tanks were visibly full. Full main and wing auxiliary tanks provided 317 L[12] of usable fuel which provided at least 4 hours endurance under normal operation. No fuel was reported as being added to either of the wingtip fuel tanks, which was consistent with advice from the aircraft owner that the wingtip tanks were not normally used for local flights.

The aircraft was also equipped with an autopilot that was capable of maintaining the aircraft's heading, altitude and pitch attitude. The autopilot servos were designed to be easily overpowered[13] by the pilot in pitch and roll and the system also incorporated a breakaway link that isolated the pitch servo in the event of a malfunction. The aircraft owner reported that the autopilot was not regularly used, and that the altitude acquire and hold functions may not have been serviceable for an extended period prior to the accident.

The aircraft was fitted with an Avgas-burning combustion heater that was located in the nose of the aircraft and provided for cabin heating and defrosting. The heater used fuel from the fuel injector unit on the right engine. Based on the ambient temperature at the time of the accident (see the section titled *Meteorological information*) it is unlikely that the heater would have been on.

Maintenance history

The aircraft's maintenance release authorised day and night VFR operation in the private category, and was valid until 12 June 2010 or 5,722.8 hours in service. At departure, the aircraft had been operated for 5,638.6 hours and there were no outstanding defects recorded.

The most recent maintenance on the aircraft was a scheduled inspection that was conducted on 12 June 2009 and the replacement of both main tyres on 18 February 2010. There were two routine maintenance items that were overdue at the time of the accident, consisting of the overhaul of the aircraft's combustion heater, which was due on 20 August 2009, and the inspection of the fire extinguisher that was due on 11 December 2009.

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12 This fuel consisted a total of 204 L in the main tanks and of 113 L in the wing auxiliary tanks.

13 Application of between 7 and 9 kg of force was required to overpower the servos.

Weight and balance

An estimation of the aircraft's weight and balance indicated that, at the time of the accident, the aircraft was operating about 214 kg below the maximum allowable gross weight of 1,690 kg[14] and forward of the forward longitudinal centre of gravity (c.g) limit by between 3 and 19 mm.[15] The manufacturer's performance data indicated that, based on the estimated weight at the time of the accident, the aircraft was capable of maintaining a cruising altitude of about 3,500 ft with one engine inoperative (OEI).

The aircraft manufacturer advised that operation at the calculated weight and balance would increase the control force necessary to manoeuvre the aircraft and the nose-up trim required during takeoff and climb. In addition, the forward c.g would increase the download on the tailplane, increase the rudder effectiveness and may increase the aircraft's aerodynamic stall airspeed. Finally, while operation below the maximum allowable gross weight would increase the minimum control airspeed with the critical engine inoperative (V_{MCA}), a forward c.g would reduce V_{MCA} (see the section titled *Asymmetric operation*).

Meteorological information

An analysis of the prevailing weather conditions was provided by the Bureau of Meteorology (BoM). That after-flight analysis stated that the:

> Likely weather conditions at the incident site during the morning of 28th March 2010...were clear skies with southeast winds between 15 and 20 knots extending to at least 4000ft above the surface. With near-surface winds of around 20 knots it is possible that some light to moderate terrain-induced turbulence would have been encountered.

The surface wind directions on the Automatic Terminal Information Service (ATIS) for Jandakot and Perth Airports at the time of the accident were consistent with the above BoM analysis. The ATIS broadcasts indicated a temperature range of between 19 °C and 23 °C at the time of the accident.

Wreckage and impact information

The accident site was located in sloping, timbered terrain adjacent to a large cleared area in which sand mining operations were conducted (Figure 2). The elevation of the accident site was about 1,050 ft.

On-site examination

Examination of the accident site identified that, while travelling in a westerly direction, the aircraft clipped the overhanging foliage of a tree before significantly impacting a second tree and the overhanging foliage of an adjacent third tree. The aircraft then travelled a further 9.5 m and collided with a fourth tree about 6 m above the ground before coming to rest at the base of that tree, facing back along

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14 Operation at a gross weight in excess of 1,633 kg required a symmetrical fuel load in the wingtip tanks.

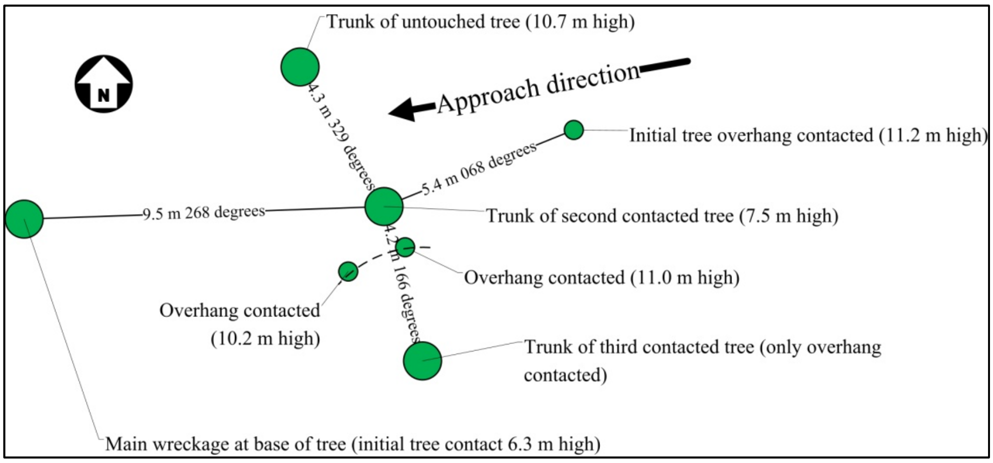
15 Variation due to uncertainty associated with the actual fuel distribution.

the approach direction (Figures 4 and 5). The aircraft occupants were found outside of the cockpit, adjacent to the main wreckage.

Figure 4: Accident site

A comparison of the aircraft's 10.6 m wingspan with the relative height and position of the contacted and untouched trees in the vicinity identified that the aircraft was banked during the contact with the second and third trees.

Figure 5: Accident site plan view



The tree contact marks indicated that the descent angle of the aircraft was between about level and 34° down immediately prior to the collision. An examination of the recovered GPS data indicated that the aircraft descended from 3,500 ft to the accident site at an average angle of about 38°.

On-site examination of the wreckage accounted for all major parts of the aircraft and confirmed the integrity of the flight control system.

The left propeller had separated from the engine during the accident sequence and was located partially embedded in the ground adjacent to the left engine (Figure 6).

Both left propeller blades appeared to be in the feathered position with no rotational damage evident.

Figure 6: Left propeller

The right propeller remained attached to the engine with one blade bent rearwards about 90° (Figure 7). Both right propeller blades appeared to be at low (fine) pitch angle.

Figure 7: Right propeller

About 11 L of fuel was recovered from the intact left wing auxiliary fuel tank and was free of water and other contaminants. The remaining bladder fuel tanks were ruptured during the collision sequence and no fuel was recovered. There was no evidence of fuel leakage from the fuel filler caps during the flight.

A damaged, 406 MHz portable locator beacon (PLB) was recovered from the aircraft wreckage (see the section titled *Emergency locator transmitters*). It had been stowed in a black pouch and was not activated.

A number of aircraft components, including the aircraft's engines and propellers, a portable GPS unit, elements of the cockpit instrumentation and a number of autopilot components were removed from the accident site for further technical examination.

Examination of recovered components

The engines, propellers, fuel selector and autopilot components were examined at a number of approved engineering facilities under the supervision of the Australian Transport Safety Bureau (ATSB). The remaining components were examined at the ATSB's technical facilities in Canberra.

Engines

Disassembly and inspection of the engines, including the associated ancillary electrical and fuel components, did not identify any pre-impact defect or anomaly that would have prevented either engine from operating normally.

Aircraft instruments

An examination of the engine tachometers identified a witness mark on the left tachometer at about zero rpm (Figure 8), and a circumferential score mark between 900 and 1,000 RPM on the right tachometer (Figure 9).

Figure 8: Left engine tachometer

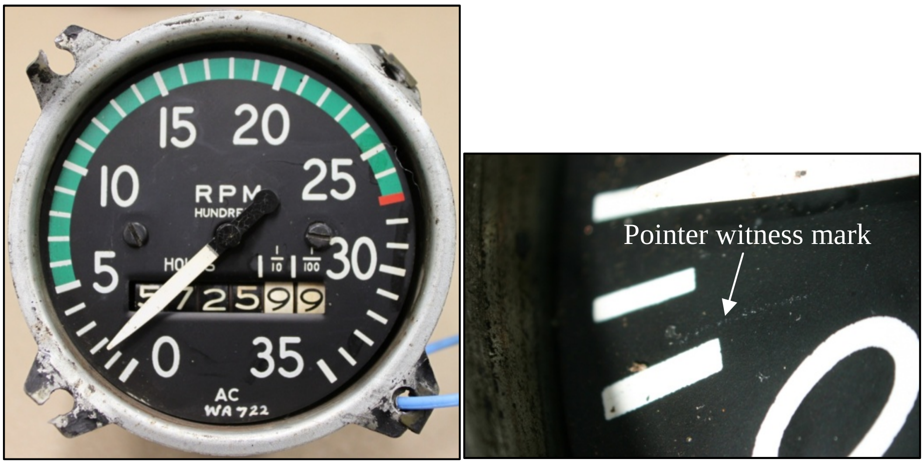
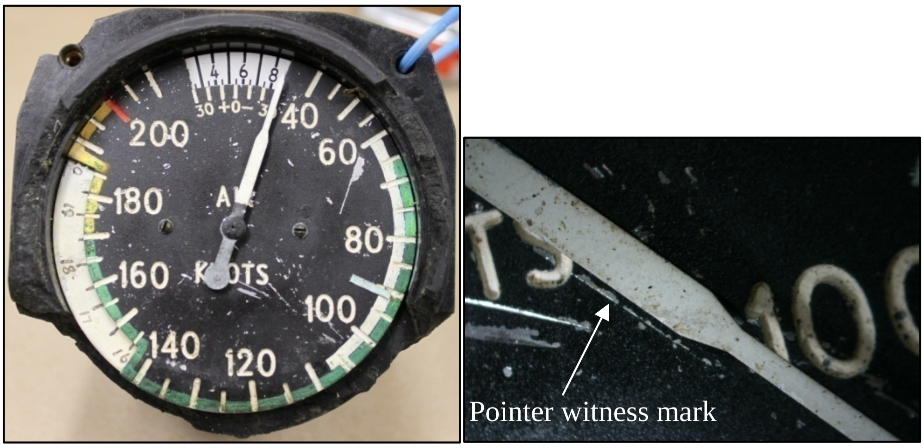


Figure 9: Right engine tachometer

In addition, a witness mark was present on the airspeed indicator (ASI) at about 100 knots (Figure 10). Examination of the face of the ASI showed a blue radial line identifying the best rate-of-climb airspeed with one engine inoperative (V_{YSE}) of 91 KIAS[16]. However, the minimum control airspeed with the critical engine inoperative (V_{MCA})[17] (see the section titled *Asymmetric operation*) was not identified. The owner of the aircraft advised that he could not recall any airspeed values marked on the glass surface of the ASI.

No witness marks were identified on the remaining aircraft instruments.

Figure 10: Airspeed indicator



Propellers

Disassembly and examination of the left propeller identified contact marks and damage that were consistent with the propeller being in the feathered position prior to impact (see the section titled *Multiengine aeroplane propellers*). Examination of the right propeller indicated that the propeller was in the low (fine) pitch position and operating at low RPM.

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16 Knots indicated airspeed.

17 V_{MCA} is marked with a red radial line on most multiengine aeroplane airspeed indicators.

Fuel system

An examination of the fuel selector assembly found corrosion in both of the filter bowls (Figures 11 and 12). Both filter elements, however, appeared relatively clear of debris and there was no evidence of particulates or blockage in any of the fuel valve ports or engine fuel system components. No evidence of water contamination was identified in either engine fuel injector unit. Water and a small amount of debris were identified within the right fuel injector filter; however, the debris was not considered sufficient to restrict the fuel flow.

Figure 11: Left filter bowl and screen

Figure 12: Right filter bowl and screen

When examined at the accident site, the left fuel selector was not in a position that represented a valid selection for flight. Later examination of the left fuel selector identified a contact mark that was consistent with the fuel selector being in the OFF position at some point during the impact sequence.

The right fuel selector was in the CROSSFEED position.

Due to the multiple forces associated with the accident sequence, it could not be determined if the observed selector positions were indicative of their pre-impact selections.

Autopilot

A number of recovered autopilot components, including the controller, pitch and roll servos, pitch trim servo, pitch control assembly and amplifier computer were examined to ascertain if the autopilot was operating prior to the accident. Despite the as-found position of the autopilot controller pitch and roll engage knobs not being in the fully OFF position[18] (Figure 13), examination of the components found no evidence that the system was in use prior to impact. Although limited by the degree of impact damage, testing of the pitch servo breakaway link and the roll servo indicated that the system was capable of being overridden by the pilot. An assessment of the pitch servo override mechanism was not possible.

Figure 13: Autopilot controller

GPS information

The on-board GPS unit retained data for a number of parameters for the flight including position, time, altitude (Figure 14) and groundspeed. Applying the meteorological data that was provided by the BoM allowed the derivation of the aircraft's calibrated airspeed[19] from the GPS-recorded groundspeed (Figure 15).

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18 The pitch and roll engage knobs must be turned fully clockwise from the OFF position to mechanically engage their respective channels.

19 Indicated airspeed corrected for air speed indicator system errors.

Figure 14: Altitude profile[20]

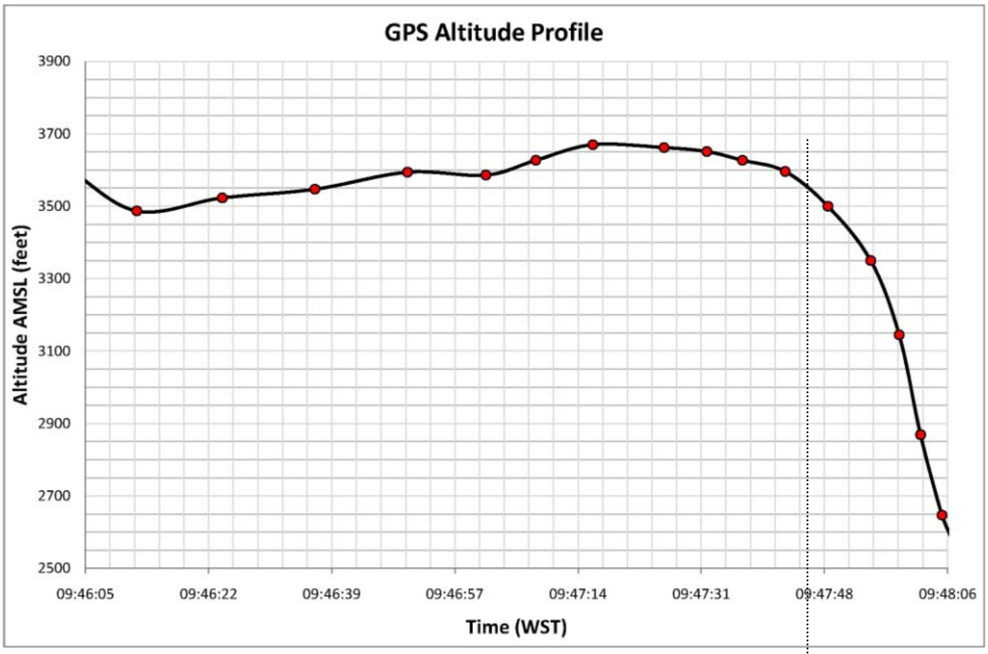
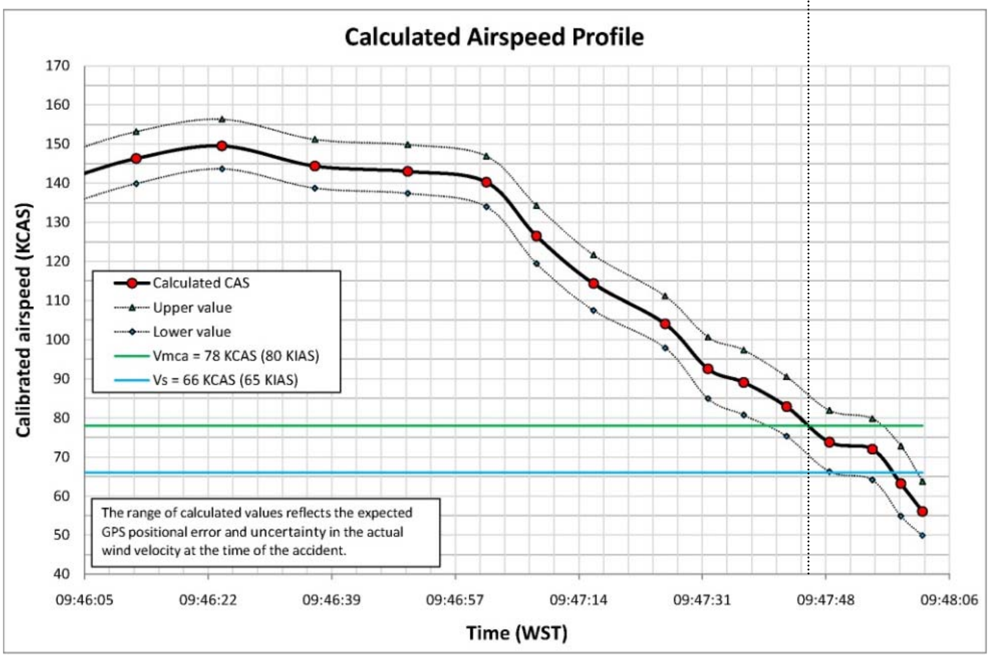


Figure 15: Airspeed profile



Medical and pathological information

A review of the pilots' aviation-related medical records identified that one had pre-existing medical conditions that had been assessed by the Civil Aviation Safety Authority (CASA) as necessitating the imposition of conditions on that pilot's

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[20] The altitude and airspeed profiles do not include the final 10 seconds of recorded data, as the accuracy of the GPS information is affected by acceleration however, the error is difficult to quantify.

medical certificate. Specifically, the pilot was required to operate with a safety pilot in a suitably-equipped aircraft that would enable the safe recovery of the aircraft in the event of an incapacitating medical event.

Given the pilots' qualifications and experience, the pilot in command (PIC) was likely to have been seated in the left seat; however, the positions of the pilots at impact could not be determined at the accident site, or via post-mortem assessment of the injuries sustained. Irrespective of the actual seating position, both pilots and the aircraft met all of the required conditions to permit either pilot to act as PIC for the flight.

Post-mortem examination of the pilots found no evidence of incapacitation that may have affected the ability of either pilot to control the aircraft.

Toxicological analysis revealed that one of the pilots had a mildly raised blood alcohol level although, given the number of factors that can influence the post-mortem production of alcohol,[21] the validity of that result could not be assured. Testing also revealed that the level of carbon monoxide saturation present in the same pilot's blood was at normal levels and insufficient to cause impairment. No analysis of blood samples was undertaken for the other pilot by the testing pathologist; however, tissue testing did not detect the presence of carbon monoxide.

The examining pathologist found that the accident was not survivable.

Additional information

Asymmetric operation

In a discussion of the transition from single to multiengine aeroplane operation, the US Federal Aviation Administration (FAA) *Airplane Flying Handbook*, stated:[22]

> The basic difference between operating a multiengine airplane and a single-engine airplane is the potential problem involving an engine failure. The penalties for loss of an engine are twofold: performance and control. The most obvious problem is the loss of 50 percent of power, which reduces climb performance 80 to 90 percent, sometimes even more. The other is the control problem caused by the remaining thrust, which is now asymmetrical. Attention to both these factors is crucial to safe OEI flight. The performance and systems redundancy of a multiengine airplane is a safety advantage only to a trained and proficient pilot.

Asymmetric control

The majority of small, multiengine aeroplanes, including the Twin Comanche, have two wing-mounted engines that produce symmetrical propeller thrust during normal operation. OEI operation of these aeroplanes results in asymmetric thrust and drag due to the offset position of the engines from the aeroplane's centreline (Figure 16).

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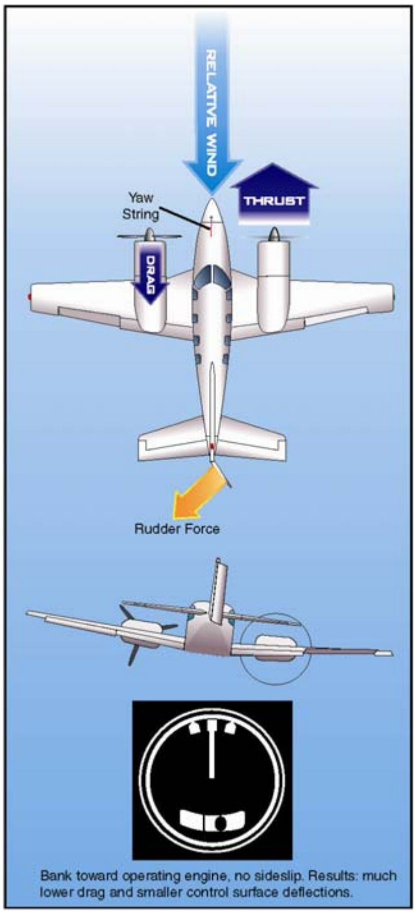
21 See the research paper Dr Shelley Robertson (2005). *Interpretation of Measured Alcohol Levels in fatal Aviation Accident Victims*: http://www.atsb.gov.au/publications/2005/Measured_alcohol_lev.aspx

22 See Chapter 12 Transition to Multiengine Airplanes: http://www.faa.gov/library/manuals/aircraft/airplane_handbook/media/faa-h-8083-3a-5of7.pdf

The result is a tendency for the nose of the aeroplane to turn in the direction of the inoperative engine. The extent of the yaw may vary depending on which engine becomes inoperative, with the inoperative engine that produces the greatest degree of asymmetry being termed the ‘critical’ engine[23].

Figure 16: OEI operation



The asymmetric yawing tendency may be countered through the application of rudder and aileron control inputs. As the effectiveness of an aircraft’s control surfaces generally decreases with decreasing airspeed, sufficient airspeed must be maintained while operating OEI to ensure that the rudder and aileron retain sufficient control authority to maintain directional control of the aeroplane.

The minimum control airspeed with the critical engine inoperative (V_{MCA}) is established by test pilots during aircraft certification under a specific set of conditions, and is marked on the ASIs of most multiengine aeroplanes with a red radial line.[24] V_{MCA} is influenced by a large number of factors, including an aircraft’s configuration and loading, any in-flight turbulence, the operating altitude and pilot technique. The actual V_{MCA} is therefore likely to be different from the published value.

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23 The left engine was the critical engine in this occurrence.

24 V_{MCA} for the accident aircraft was 80 KIAS. This airspeed was not identified on the ASI.

In respect of the demonstration of V_{MCA}, which is required during a pilot's initial multiengine endorsement training, the manufacturer stated:

> The engine out minimum control speed demonstration required for the FAA flight test for the multi-engine rating approaches an uncontrolled flight condition with power reduced on one engine. The demonstration should not be performed at an altitude less than 3500 feet above the ground. APPROACH V_{MC} WITH CAUTION. Initiate recovery during the demonstration by immediately reducing power on the operating engine and promptly lowering the nose of the airplane.

Asymmetric performance

In regard to the operation of the Twin Comanche following an engine power loss, the manufacturer stated:

> If engine failure occurs during the climb out after take-off, maintain directional control with rudder and ailerons, and establish the best single engine rate of climb airspeed (105 mph [91 KIAS] at sea level). Speeds below or above the best rate of climb speed optimum will result in lower than optimum rate of climb.

Flight at the best rate of climb speed with one engine inoperative (V_{YSE}) is also applicable during the cruise, as it provides the minimum rate of descent in the event that the aircraft is unable to maintain altitude following a single engine power loss. OEI climb performance is also dependent on the relative application of rudder and ailerons. The need for the optimum combination of these controls was discussed in the FAA handbook as follows:

> Rudder and ailerons used together will result in a bank of approximately 2° of bank towards the operative engine...The result is zero sideslip [Figure 16] and maximum climb performance. Any attitude other than zero sideslip increases drag, decreasing performance.

V_{MCA} and stall speed

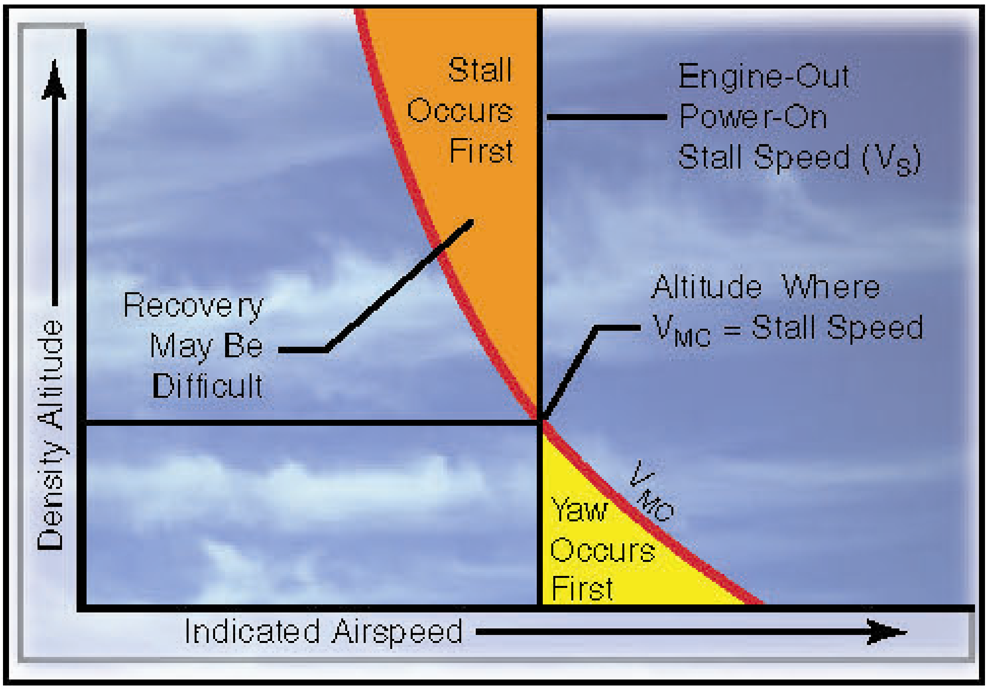
The manufacturer's advice for the practice of stall manoeuvres, and description of the stall characteristics of the Twin Comanche included:

> When practicing stalls maintain minimum terrain clearance of 5000 feet. Single engine or asymmetric power stalls [are] prohibited...The left wing on the Twin Comanche with clockwise rotating propellers will, generally speaking, under conditions of moderate symmetrical power, stall more rapidly than the right wing, and if recovery is not promptly initiated, the airplane will have a tendency to roll to the left.

The interaction between V_{MCA} and stall speed (V_S) was discussed in the FAA handbook as follows (Figure 17):

> V_{MC} decreases with altitude. Stalling speed (V_S), however, remains the same. Except for a few models, published V_{MC} is almost always higher than V_S. At sea level, there is usually a margin of several knots between V_{MC} and V_S, but the margin decreases with altitude, and at some altitude, V_{MC} and V_S are the same...Should a stall occur while the airplane is under asymmetrical power, particularly high asymmetrical power, a spin entry is likely...Where V_S is encountered at or before V_{MC}, the departure from controlled flight may be quite sudden, with strong yawing and rolling tendencies to the inverted position, and a spin entry...Twins are not required to demonstrate recoveries from spins, and their spin recovery characteristics are generally very poor.

Figure 17: V_{MCA} and stall speed



The manufacturer's spin recovery technique in the Twin Comanche required the pilot to:

> 1. Retard both throttles to idle position.
> 2. Apply full rudder in the opposite direction to the spin.
> 3. Push control wheel full forward. While it is not necessary for recovery, the use of ailerons against the turn...will expedite recovery. Maintain controls in these positions until rotation stops. Then neutralize rudder and ailerons.
> 4. Recover from dive with smooth back pressure on control wheel. No abrupt control movement should be used during recovery from the dive.
>
> NOTE
>
> Altitude loss in a spin may be in excess of 2000 feet. Avoid any maneuver which might result in a spin at low altitude. The more rapidly spin recovery is begun the more prompt recovery will be.

Multiengine aeroplane propellers

In the event of an engine power loss, the inoperative engine may continue to rotate due to the airflow acting on the propeller. The FAA handbook described the hazard of a windmilling propeller as follows:

> A propeller windmilling at high RPM and low pitch can produce an increase in parasite drag which may be as great as the parasite drag of the basic airplane.

In order to minimise this significant source of drag on single engine climb performance, the propellers of multiengine aeroplanes are capable of aligning the blades with the airflow (Figure 18). This 'feathered' configuration stops the rotation of the engine and propeller and significantly reduces the parasite drag compared to that associated with a windmilling propeller (Figure 19).

Figure 18: Multiengine aeroplane propeller

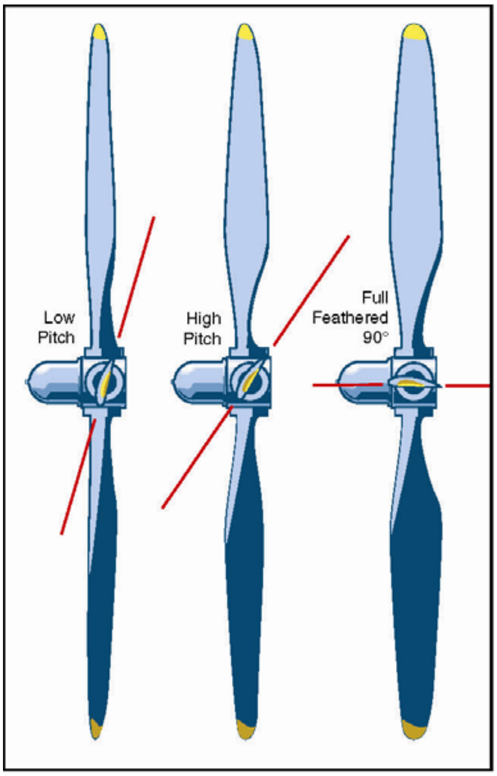
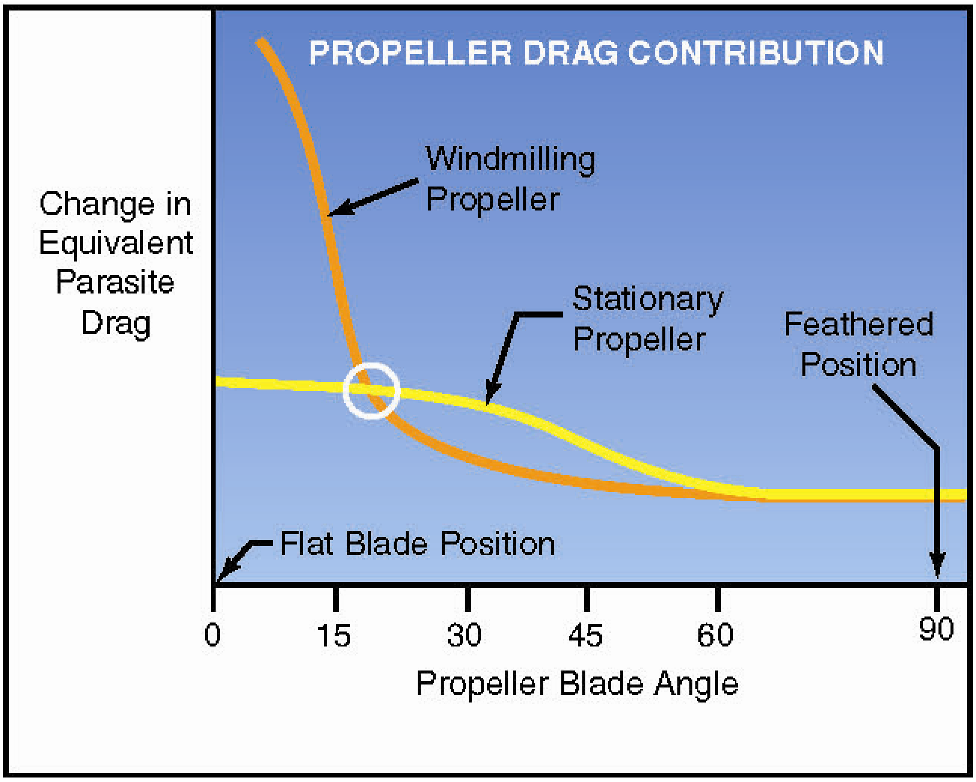


Figure 19: Propeller drag



Multiengine aeroplane propellers use high pressure engine oil to prevent the blades from feathering during normal operation. In the event of a loss of engine oil pressure, such as associated with an engine failure, forces acting on counterweights within the propeller hub, assisted by a pressure charge or spring, move the blades towards the feathered position. In order to prevent the blades from feathering due to the reduction in oil pressure associated with a normal engine shutdown, a latch mechanism engages at low RPM.

The manufacturer's advice concerning feathering of the propellers stated:

> The propellers...are controlled entirely by use of the propeller control levers located in the centre of the power control quadrant. Feathering of the propellers is accomplished by moving the controls fully aft through the low RPM detent into the feathering position. Feathering takes place in approximately three seconds.
>
> ...The Hartzell HC-E2YL-2 feathering propellers can be feathered only while the propeller is rotating above 1000 RPM. Loss of centrifugal force due to slowing RPM will actuate a stop pin [latching mechanism] that keeps the propeller from feathering each time the propeller is stopped on the ground.

Other occurrences

During the course of this investigation the ATSB was advised of an accident that occurred during the conduct of a practice engine failure following takeoff in a Twin Comanche aircraft. The instructor in that aircraft reported that, following a simulated failure of the right engine, the student incorrectly moved the pitch lever of the operative left engine towards the high (coarse) pitch setting. The aircraft rapidly stalled and entered a spin with the right wing dropping to about 120° angle of bank. The instructor managed to regain control of the aircraft; however, due to the low operating altitude, the aircraft collided with terrain, injuring the instructor.

A review of occurrences investigated by the US National Transportation Safety Board (NTSB) identified a number of accidents resulting from in-flight loss of control of Twin Comanche aircraft following a single engine power loss, including:[25]

> While on a long cross country flight, the left engine shut down in-flight and had to be restarted. The pilot then landed and refuelled the airplane...About 2 hours later, while maneuvering near New Philadelphia, Ohio, a review of the last 4 minutes of recorded GPS data revealed the airplane had decelerated from 110 miles per hour (mph) to 84.9 mph, and descended from 1,699 feet to 923 feet, before the data ended. Witnesses heard the airplane having engine trouble, and observed the airplane make a left turn, then roll upside down, before it hit the ground...
>
> The National Transportation Safety Board determines the probable cause(s) of this accident as follows:
>
> The pilot's mismanagement of the fuel, and his failure to maintain minimum controllable airspeed with one engine inoperative.

Flight notification requirements

In regard to the flight notification requirements affecting VFR flights, the Aeronautical Information Publication (AIP) stated that:[26]

> Pilots of VFR flights nominating a SARTIME [search and rescue time[27]] to ATS [air traffic services], and those intending to operate in controlled airspace (except for VFR flights in Class E airspace and GAAP CTRs [General Aviation Aerodrome Procedure control zone]) must submit flight details to ATS.
>
> VFR flights in the following categories are required to submit a SARTIME flight notification to ATS, or, as an alternative, to leave a Flight Note with a responsible person:
>
> a. RPT [regular public transport] and CHTR [charter] flights;
> b. Over-water flights;
> c. Flights in Designated Remote Areas
> d. Flights at night proceeding beyond 120NM [222 km] from the aerodrome of departure.

At the time of the accident the Jandakot Airport CTR operated under GAAP and therefore there was no requirement to submit flight details to ATS. Additionally, the categorisation of the flight did not require the nomination of a SARTIME.

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25 See NTSB occurrence investigations FTW99FA222 (1999), MIA07FA117 (2007), DEN91FA126 (1991), and LAX03FA093 (2003) (http://www.ntsb.gov/ntsb/query.asp).

26 The requirements were amended on 3 June 2010 to reflect the transition of control zones (CTR) associated with General Aviation Aerodrome Procedures (GAAP) airports, such as Jandakot, to Class D airspace.

27 A SARTIME was a nominated time by which a pilot intended to contact ATS to confirm the normal operation of his or her aircraft. Failure to report by the nominated time results in the initiation of search and rescue action by ATS.

In respect of the provision of SAR services, the AIP stated:

> The efficacy of the SAR action by Airservices or AusSAR is directly related to the amount and accuracy of details notified in the flight notification or flight note, and to any position details reported in flight.

Emergency locator transmitters

Emergency locator transmitters are electronic devices that use orbiting satellites to pass distress signals to SAR organisations. The requirements affecting the fitment or carriage of ELTs are detailed in Civil Aviation Regulation (CAR) 252A. CAR 252A (1) stated:

> (1) The pilot in command of an Australian aircraft that is not an exempted[28] aircraft may begin a flight only if the aircraft:
>
> (a) is fitted with an approved ELT:
>
> (i) that is in working order; and
>
> (ii) whose switch is set to the position marked 'armed', if that switch has a position so marked; or
>
> (b) carries, in a place readily accessible to the operating crew, an approved portable ELT that is in working order.

The personal locator beacon (PLB) that was carried on board the aircraft met the requirements for an approved portable ELT detailed in sub-regulation 1. The principal difference between an approved ELT and an approved portable ELT is that the former is automatically activated on impact, whereas a portable ELT must be manually activated.

[28] Exempted aircraft are defined in CAR 252A (7). The accident aircraft was not an exempted aircraft.

ANALYSIS

The data from the onboard global position system (GPS) and the physical evidence at the accident site indicated that, during the return to Jandakot Airport in good weather conditions, the aircraft's airspeed decreased followed by a loss of control. Examination of the aircraft and associated systems did not identify any engineering defect or failure that contributed to the development of the accident. The results of the pilots' post-mortem examinations and toxicological testing did not identify any evidence of incapacitation that may have affected either pilot. That included the potential for the non-completion of maintenance on the combustion heater to have resulted in carbon monoxide poisoning in the unlikely event that the heater was selected ON.

The following discussion examines a number of other factors with the potential to have contributed to the loss of control.

Development of the accident

Technical examination of the left propeller and associated engine tachometer identified that the left propeller was feathered prior to impact. The derived airspeed profile in the minute before the descent was consistent with the operation of the aircraft with one engine inoperative (OEI). Although there was sufficient time to have feathered the propeller during the steep descent, any pilot recovery action is unlikely to have involved the intentional feathering of a propeller. It was therefore considered likely that the left propeller was feathered prior to the descent.

An assessment of the right propeller and engine tachometer identified that the right propeller was operating at low RPM and low (fine) pitch prior to impact. Low RPM on the right propeller, although consistent with an attempt to recover from a loss of control, may have also reflected a problem with the right engine.

In the absence of any evidence of a technical defect or failure, the investigation considered the possible circumstances that would have required the shutdown of the left engine and subsequent feathering of the propeller. Based on the quantity of fuel onboard at the commencement of the flight, and the amount recovered from the intact auxiliary tank, fuel exhaustion or starvation were both considered unlikely at normal fuel consumption rates. Similarly, there was no evidence of a fuel leak or other fuel system defect that would have produced a fuel-related power loss. The investigation also considered the possibility of a power loss due to fuel selector mismanagement; however, the uncertainty associated with the pre-impact selector position precluded an assessment. Additionally, in the event of inadvertent fuel starvation, an engine restart should have been possible without recourse to propeller feathering, provided that the problem was correctly identified.

Based on the presence of water within the right fuel injector filter, the possibility that fuel contamination may have affected the one or both engines was also considered. The evidence of long-term corrosion and the advice of the owner concerning use of the fuel drains, indicated that the aeroplane had probably operated uneventfully with water present in the fuel selector drains on previous occasions. Given that the aircraft had flown for over an hour prior to the accident, it was considered probable that a change in fuel tank selection would have been required to facilitate a power loss due to fuel contamination. As previously stated however, the in-flight fuel selector positions could not be confirmed.

Irrespective of the reason for the left engine shutdown, the manufacturer's performance data indicated that the aircraft was controllable and probably capable of maintaining altitude with OEI. The deceleration of the aircraft towards V_{YSE} evident from the global position system (GPS) data, was consistent with the ideal response to a power loss; however, the continued airspeed reduction towards the nominal V_{MCA} airspeed resulted in loss of control of the aircraft. The varying degree of possible asymmetry indicated by the propeller examinations, combined with the number of factors that affect the actual V_{MCA} and stall airspeeds, meant that the loss of control may have been associated with asymmetric operation, a stall/spin or a combination of both. Irrespective of the actual mechanism, the accident was consistent with a loss of control due to insufficient airspeed.

The investigation was unable to determine the extent to which the out of limits forward centre of gravity may have contributed to the loss of control.

The relative inexperience of both pilots and apparent lack of recency in the conduct of emergency procedures in multiengine aeroplanes increased the likelihood that a malfunction, especially a partial or fluctuating power loss, may not have been diagnosed and managed appropriately. The absence of a distress call indicated that the pilots probably experienced significant workload in responding to the situation. This may have resulted in the unintended deceleration of the aircraft below a safe airspeed.

The indicative altitudes required for spin recovery and the recommended safety heights associated with the practice of stalling and V_{MCA} demonstrations indicated that control recovery may not have been possible within the available height above the surrounding terrain.

Emergency response

Since no detail of the intended flight was provided to either Air Traffic Services (ATS) or left with any other person, an emergency response relied on either a distress call or selection of an emergency transponder code by the pilot, observation of the accident or, as in this case, notification by a concerned third party that the aircraft had not returned to Jandakot Airport. The absence of an alerting distress call or selection of an emergency transponder code by the pilots, presumably due to the significance of the emergency, meant that the detection of the emergency by ATS relied on the observation of a radar trace that was outside of the controller's responsibility and focus. Similarly, the witness observations on the morning of the accident were not associated with an aircraft in distress until they became aware that an aircraft was missing.

Recognising that there was no requirement for details of the flight to be provided to ATS or other agencies, the lack of such information hampered the search and rescue (SAR) response to this accident. If information on the intended flight route had been available, it would have led to a focussed search effort that would probably have resulted in the rapid location of the aircraft and occupants. Additionally, although the carriage of a portable emergency locator transmitter (ELT) complied with the relevant regulations, an automatic impact activation feature may have provided the SAR agency with more timely advice that the aircraft was in distress.

Although earlier location of the aircraft would not have reduced the severity of the outcome in this instance, the availability of accurate flight information will generally provide for a more timely emergency response.

FINDINGS

From the evidence available, the following findings are made with respect to the collision with terrain that occurred 43 km east of Perth Airport, Western Australia on 28 March 2010 and involved Piper Aircraft Corp. PA-30, registered VH-KDS. They should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factors

- During cruise, the airspeed decreased to the extent that control of the aircraft was lost.

Other safety factors

- The aircraft was operating outside of the longitudinal centre of gravity limits at the time of the accident.
- The location of the aircraft was delayed due to the lack of flight details available for the search and rescue authorities and the non-activation of the portable emergency locator transmitter.

Other key findings

- The crew complied with all requirements relating to flight notification and the carriage of emergency locator transmitters.

APPENDIX A: SOURCES AND SUBMISSIONS

Sources of Information

The sources of information during the investigation included:

- the owner of the aircraft
- the aircraft maintenance records
- the pilot's endorsing instructor
- a hearing witness to the accident
- the aircraft refueller and refuelling documentation
- the aircraft manufacturer
- the United States National Transportation Safety Board (NTSB)
- the Australian Maritime Safety Authority (AMSA)
- the Bureau of Meteorology
- the Civil Aviation Safety Authority (CASA)
- Airservices Australia.

References

United States Federal Aviation Administration, *Airplane Flying Handbook.*

http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/airplane_handbook/ retrieved on 9 December 2010.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the manufacturer, owner and maintainer of the aircraft, CASA, AMSA and the NTSB. Submissions were received from the owner of the aircraft and AMSA. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

Collision with terrain – 43 km east of Perth Airport, WA, 28 March 2010,
VH-KDS, Piper Aircraft PA-30-160B Twin Comanche