



Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Investigation – 200700358

Final

**Engine power loss
15 km SE Gold Coast Airport, Qld
4 February 2007**

VH-DIC

Piper Aircraft Co. PA-30 Twin Comanche



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Abstract

On 4 February 2007, the owner-pilot of a Piper Aircraft Co. PA-30 Twin Comanche aircraft, registered VH-DIC, was conducting a private flight from Gold Coast Airport, Qld. The pilot was the sole occupant. Approximately 11 minutes into the flight, at 1622 Eastern Standard Time, the pilot declared an emergency reporting an engine failure and some 15 seconds later that he was also experiencing problems with the 'left engine'. Approximately 13 minutes after departure, the aircraft impacted the water about 100 m off Kingscliff beach, adjacent to the suburb of Casuarina, NSW. The pilot received fatal injuries.

Two days following the accident, the aircraft wreckage including most of the lower centre fuselage, wings, and both engines and propellers, was recovered and examined. The right propeller was recovered with the blades in the feathered position. The left propeller was recovered with the blades in the normal operating range with bending consistent with power being applied at the time of the impact with the sea.

The investigation determined that most probably the right engine stopped operating, followed by an unexplained power loss of the left engine. The aircraft airspeed then decreased below the minimum controllable airspeed during the emergency landing before power suddenly returned to the left engine causing the aircraft to pitch nose up and bank sharply to the right and impacting the water.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government. ATSB investigations are independent of regulatory, operator or other external bodies.

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 enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, 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 proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

FACTUAL INFORMATION

History of the flight

At 1612 Eastern Standard Time¹ on 4 February 2007, the owner-pilot of a Piper Aircraft Co. PA-30 Twin Comanche aircraft, registered VH-DIC (DIC), departed the Gold Coast Airport, Qld on a private flight to the local flying training area. The pilot was the sole occupant. About 11 minutes into the flight, the pilot reported to the Gold Coast Aerodrome Controller (ADC), ‘...I have an engine failure and I’m declaring an emergency’. Fifteen seconds later, the pilot advised that he was also experiencing problems with the left engine. At about 1626, the aircraft impacted the water about 100 m offshore from the suburb of Casuarina, NSW. The pilot received fatal injuries.

Recorded radar data showed that after takeoff, the aircraft had tracked south towards the flying training area, reaching groundspeeds of up to 138 kts. At 1617:56 the aircraft turned towards the south-east and at 1619:56 the aircraft turned to the north-north-west towards the Gold Coast Airport. After that turn, the radar data showed that the aircraft maintained 1,500 feet above mean sea level (AMSL) with a groundspeed of about 160 kts. From 1621:25 to 1622:20, the groundspeed reduced to below 100 kts. After 1621:35, the aircraft descended at about 650 ft/min, which continued until it was below radar coverage (Figure 1). The last radar derived groundspeed was 89 kts (see Appendix A for further details concerning recorded radar data).

Witnesses located on or near the beach at Casuarina reported seeing the aircraft flying north at a low height, either over, or just off, the beach. Those witnesses reported that at that time there was very little engine noise.

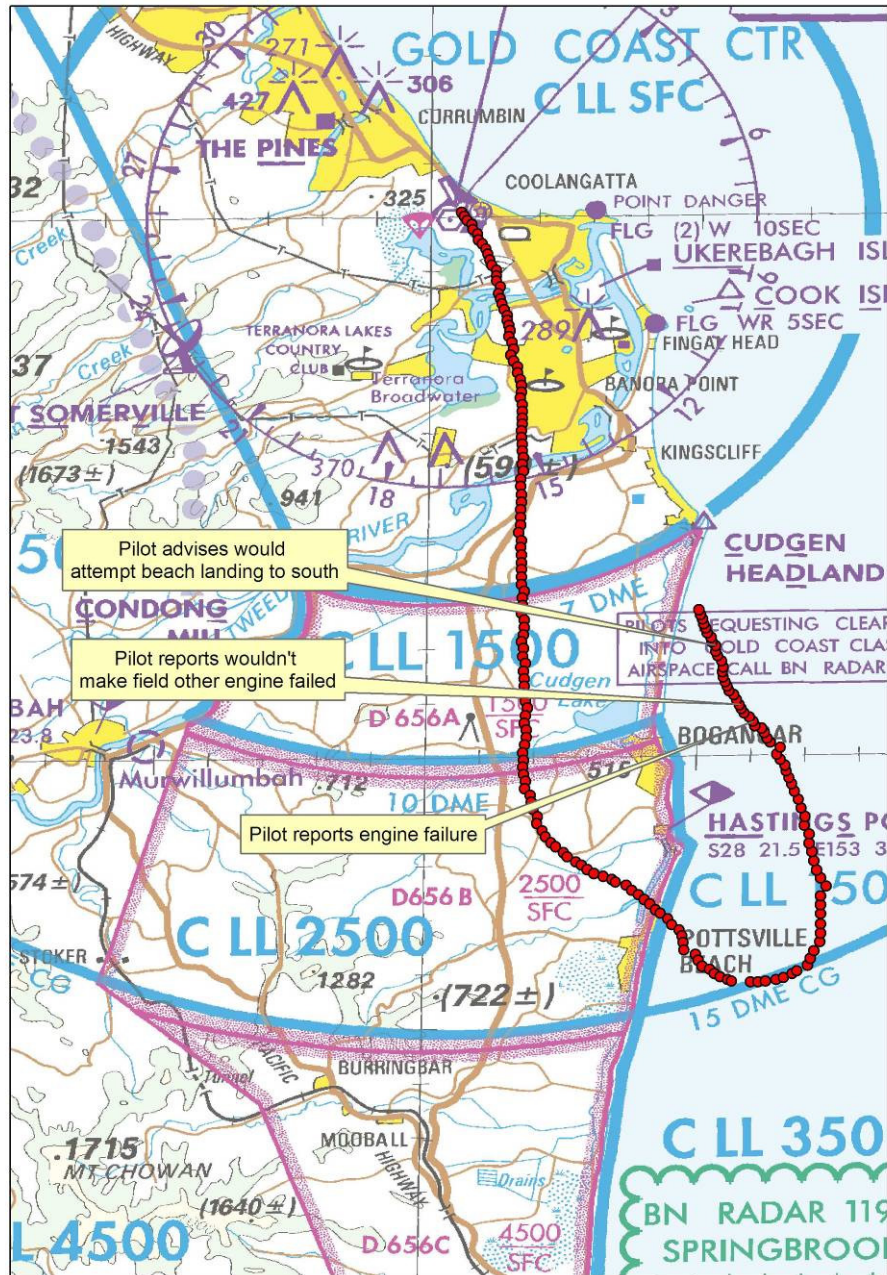
The aircraft was then observed to pitch up and bank sharply to the right. The witnesses reported hearing a variety of sounds associated with the aircraft’s pitch up including:

- an increase in engine noise
- a loud bang
- a noise like a ‘bullroarer’²
- a vibrating engine sound like ‘a diesel four-wheel-drive engine’
- a surge in engine noise.

¹ The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time, as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

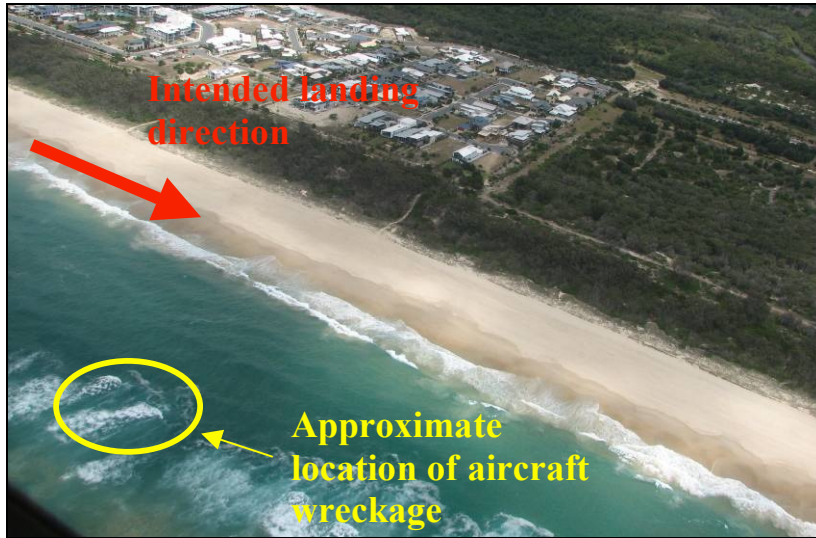
² A bullroarer is an ancient ritual musical instrument and means of communicating over extended distances.

Figure 1: Radar track of aircraft's flight



The aircraft remained banked to the right and descended steeply into the water, just beyond the wave zone/shore break (Figure 2). Weather in the area at the time of the accident was generally fine, with no cloud and wind from the south-east at 19 kts.

Figure 2: Aerial view of the accident site



Communications

The following is a summary of the recorded communications between the pilot and the ADC (Table 1).

Table 1: Recorded communications

Time	Event
1601:00	The pilot advised the ADC that he intended to conduct a check flight to the flying training area.
1604:31	The pilot requested, and received, a clearance to taxi and track to the flying training area at 1,500 ft [AMSL].
1611:24	The pilot was cleared to take off from runway 14.
1622:03	The pilot reported, 'Gold Coast tower this is Delta India Charlie [DIC] I have an engine failure and I'm declaring an emergency'.
1622:09	The controller acknowledged the emergency, issued a clearance for the pilot to track direct to the airport, and asked the pilot if he could maintain height and if he required a higher level.
1622:17	The pilot advised, 'DIC that's a negative I don't think I'll make the field I've got a ..I've got a lot of problems with the left engine as well I might have to do a beach landing'.

1623:04	The pilot advised, 'Gold Coast this is DIC I'm going to turn in for a southern beach landing here'.
1623:11	The controller acknowledged the pilot's radio transmission.
1623:14	The pilot advised, 'DIC that's a negative I don't think I will make it I'll have to land into the north'.

No further transmissions were received from the pilot.

Pilot information

The pilot was appropriately qualified to conduct the private category flight. At the time of the accident, he held a Commercial Pilot (Aeroplane) Licence, a Class 2 medical certificate, and a Piper PA-30 Twin Comanche aircraft endorsement. He had previously held a Grade 2 instructor rating for single-engine aircraft.

He had accrued approximately 2,544 hrs total flying experience, of which 943 hrs were in DIC, including 20 hrs in the previous 90 days. His total experience in multi-engine aircraft was 1,060 hrs.

On 25 April 2005, the pilot had completed a 1-hour Aeroplane Flight Review with an authorised testing officer, which included a Command Instrument Rating renewal³.

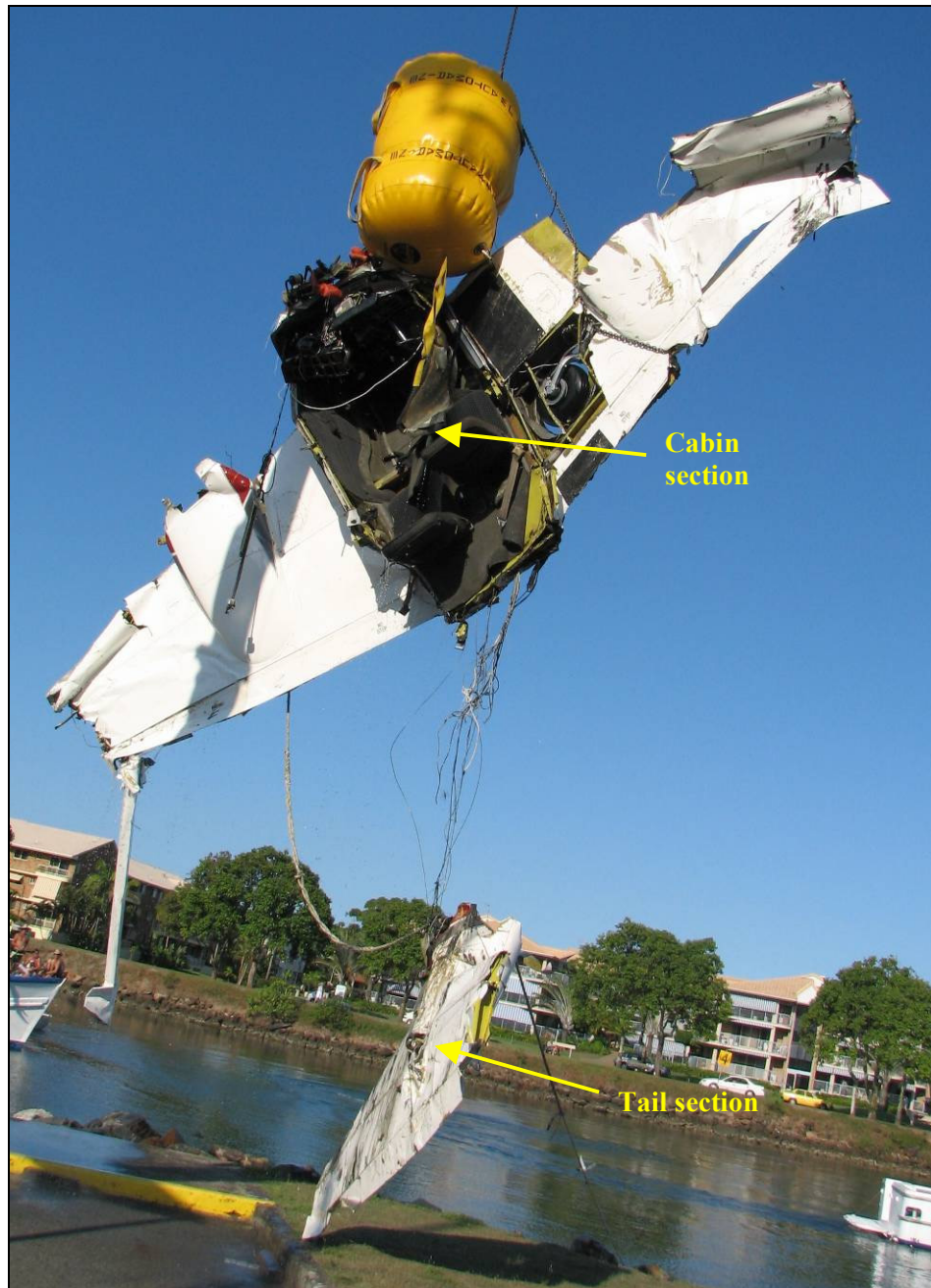
Several persons interviewed reported to the investigation that the pilot's knowledge of some of the aircraft's systems was limited, in some aspects, and that he had in the past 'self-induced' engine/propeller problems.

Wreckage examination

With the assistance of New South Wales Water Police Divers, the Australian Transport Safety Bureau (ATSB) recovered the aircraft engines and main wreckage and transported these items to a secure facility for further examination. The wreckage recovered consisted of most of the lower centre fuselage, the wings, the remains of the tail section (Figure 3) and both engines with propellers.

³ This included aircraft handling with an engine failed after takeoff, during an approach and a missed approach.

Figure 3: The aircraft as recovered



Aircraft debris consisting of two wing tip tanks, a seat, and a number of pieces of the fuselage and wing skin were recovered from the beach after the accident.

The following items were not recovered:

- cabin roof with windows and door
- approximately 1.8 m of the outboard section of each wing
- right aileron
- right auxiliary fuel tank
- approximately 1.5 m section of empennage

- approximately 0.6 m outboard section of the left horizontal stabiliser and elevator
- vertical stabiliser and rudder.

Examination of the aircraft structure indicated that the aircraft initially impacted the water with the right wing, and broke up while cart wheeling. The main landing gear and flaps were retracted.

Continuity was confirmed to the primary control surfaces. Continuity of the engine controls was confirmed only to the engine firewalls as the control cables had been cut during engine recovery. The trim settings for the elevator and rudder trim were unreliable because of airframe/fuselage disruption.

Because of fuselage disruption, the position of the engine and propeller controls at the time of impact could not be confirmed. The right engine and propeller were recovered with the blades in the feathered position⁴, with minimal deformation of the blades. The left engine and propeller were recovered with the propeller blades in the normal operating range with deformation consistent with power being applied at the time of the impact with the water. Additionally, the left propeller spinner had impact crush damage indicating rotation at the time of impact (Figure 4).

Figure 4: Right and left propellers

Right engine/propeller



Left engine/propeller



Witnesses reported fuel floating on the water near the wreckage. The fuel selectors for the left and right engines were selected to MAIN, the boost pumps were selected to OFF and the magnetos were selected to ON. No fuel was recovered from the right main fuel tank, which was breached during impact. The left main tank contained a mixture of fuel and water consisting of 1.5 L of fuel and 18 L of water. The right auxiliary fuel tank was not recovered. The left auxiliary fuel tank contained a mixture of fuel and water consisting of 24 L of fuel and 23 L of water. Both wing tip fuel tanks had been separated. Initial recovery of the tip tanks noted an unmeasured amount of fuel in the tip tanks estimated to be about 30 L (Table 2).

⁴ Turning propellers to the feathering angle, following engine failure or apparent malfunction, to minimise drag and prevent further damage.

Table 2: Fuel system capacities and recovered fuel

Tank location	Capacity usable	Amount recovered	Notes
Left wing tip	57 L	Unknown ⁵	Separated
Right wing tip	57 L	Unknown	Separated
Left auxiliary	57 L	24 L	
Right auxiliary	57 L	0 L	Not recovered
Left main	102 L	1.5 L	
Right main	102 L	0 L	Breached

The fuel lines were traced from the wings to the selectors and no abnormalities were found other than that due to impact damage and/or aircraft recovery activities. The fuel selectors and boost pumps were examined and that revealed nothing that would have prevented fuel flowing freely to the respective engines.

Medical and pathological information

A review of the pilot's medical records held by the Civil Aviation Safety Authority (CASA) indicated no pre-existing disease or condition that had the potential to affect his performance. A post-mortem report and toxicology testing results indicated no factors that would have affected the pilot's performance.

Previous event and flights

On 30 January 2007, the pilot conducted a return flight from the Gold Coast Airport to Bundaberg, Qld in DIC. After returning to the Gold Coast Airport, the pilot reported to local maintenance personnel⁶, an uncommanded feathering of the right propeller, and that the aircraft had an unusual vibration on entering the circuit in preparation for landing. He also told them that he initially thought that the aircraft had sustained an engine failure as the engine instruments 'were all over the place'. Maintenance personnel reported that the pilot said it was possible that he had feathered the right propeller unintentionally⁷. Maintenance personnel were unable to manually unfeather the right propeller and assisted the pilot in parking the aircraft in its hangar. Manually unfeathering the propeller is accomplished by physically moving the propeller blades to unlock them. It could not be established whether the pilot experienced any problems with the aircraft on arrival or departure from Bundaberg during that flight.

On 31 January 2007, the pilot returned to the maintenance facility that had assisted him earlier and asked about charges for their assistance. He told the maintenance personnel that 'he had run the engines and everything was fine'. Maintenance personnel who normally maintained the aircraft said that the owner had telephoned them on 1 February 2007 to report the problem with uncommanded feathering, and that he declined their offer of assistance.

⁵ Fuel from these tanks was collected in a single drum by rescue personnel.

⁶ The Gold Coast Airport maintenance personnel did not normally maintain the aircraft - it was maintained by an engineer located elsewhere.

⁷ Another engineer reported that the pilot had previously done this while on a flight to Norfolk Island.

The Twin Comanche Owner's Handbook outlined propeller unfeathering procedures while in flight:

The propellers are Hartzel HC-E2YL-2 constant-speed, controllable, full-feathering units. These are controlled entirely by use of the propeller control levers located in the center 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. A propeller is unfeathered by moving the prop control ahead and engaging the starter.

A witness who lived near the airport observed an apparent problem with the aircraft's right engine several days prior to the accident. He saw the engine stopping and being restarted a number of times on the taxiway and stated that eventually the aircraft was taxied back to the parking area. He saw the aircraft depart about half an hour later.

The ADC also recalled the pilot having problems with the right engine on the taxiway and asked the pilot if 'everything was OK', to which the pilot responded 'yep-yep everything was fine, just had to clear a fuel embolism'. A few minutes later, the aircraft was taxied back to the hangar.

Aircraft fuel

The aircraft had six fuel tanks and according to the Twin Comanche Owner's Handbook, it had a total fuel capacity of 454 L, while total usable fuel⁸ for the aircraft was 432 L.

The aircraft's fuel quantity system was last calibrated on 25 November 2002. A witness reported to the investigation that the aircraft's fuel quantity gauges were 'unreliable' and that the pilot had manufactured and calibrated a 'dip stick' to more accurately verify fuel levels.

On 29 January 2007, all of the aircraft's fuel tanks were refuelled to full prior to the flight to Bundaberg. There was no record of any further refuelling of the aircraft prior to the accident flight. The fuel remaining in the tanks after the wreckage recovery was contaminated with sea water and was unable to be reliably tested. There were no reports, relating to fuel quality, by operators of other aircraft that had been refuelled from the same source as DIC.

Recorded information indicated that the flight to Bundaberg and return was about 3.7 hour's duration. The investigation calculated that the total consumption of fuel for the flight to Bundaberg and return and the accident flight was about 313 L, indicating that at the time of the accident, approximately 119 L of usable fuel should have remained in the aircraft fuel system (see Table 2 for further information)⁹. The distribution of the fuel remaining within the aircraft's fuel system could not be determined.

⁸ Defined as fuel actually available, with no reserve, typically 95-98% of system capacity.

⁹ A small amount of fuel may have been used during engine checking on the ground between 30 January and 4 February 2007.

The Twin Comanche Owner's Handbook contained a notation:

Since a fuel injected engine such as is used on the Twin Comanche takes an appreciable length of time to start after fuel starvation, it is recommended that you avoid emptying a fuel cell [tank] to depletion. If the engine should stop because a fuel cell is depleted of fuel be prepared to wait a while for the engine to start after changing to a fuel cell with fuel in it.

The handbook also stated that fuel should be used from the main fuel tanks during takeoff, landing, climb and descent, and that the auxiliary fuel and tip tank fuel should be used in level flight only.

It was reported that during an instrument rating renewal, the testing officer questioned the pilot on whether the amount of fuel on board the aircraft was sufficient for the flight. The pilot showed reluctance in adding more fuel citing concern with the expense. It was also reported to the investigation that on one occasion, the pilot had requested the tip tanks be refuelled, but that he did not physically check the levels before flight. During that flight, he reportedly selected the tip tanks on three occasions, resulting in engine fuel starvation, before realising that they had not been filled as requested.

Aircraft owner's handbook and emergency procedures

According to the Twin Comanche Owner's Handbook, the aircraft's cruise speed at 4,200 ft AMSL and normal power settings was 172 kts true airspeed (TAS). The stalling speed with landing gear and flaps retracted and engine power off, was 67 kts and the velocity minimum control speed (Vmc)¹⁰ was 79 kts.

The handbook included emergency procedures for asymmetric flight. Those procedures stated:

(b) During Cruise Flight

If the engine failure occurs during cruise flight, maintain airspeed and directional control of airplane; immediately advance mixture, propeller and throttle controls. The airplane will yaw in the direction of the inoperative engine. It will rarely be possible to immediately locate the inoperative engine by viewing the manifold pressure gauge. This yaw in direction of the inoperative engine can be corrected with rudder and rudder trim.

Carefully retard the throttle control of the suspected inoperative engine in order to identify the malfunctioning engine and verify that it is not producing power. Turn on fuel pumps, check ignition switches, fuel gauges and fuel cell selectors and try to determine cause of the engine failure. If power cannot be regained, the propeller on the inoperative engine should be feathered by retarding the throttle to the idle position and moving the propeller pitch control into the feathered position. The mixture should then be moved to idle cut-off and ignition turned off.

¹⁰ Vmc was the calibrated airspeed, determined by the US Federal Aviation Administration test pilots, below which a twin-engine aircraft cannot be controlled in flight with one engine operating at take-off power and the other engine propeller windmilling.

The handbook also addressed single engine approach issues stating:

Maintain additional altitude and speed during approach, keeping in mind that landing should be made right the first time and that a go-around may require the use of full power on the operating engine, making control more difficult.

A final approach speed of 105 miles per hour [91 kts] and the use of half rather than full wing flaps will place the airplane in the best configuration for a go-around should this be necessary, but it should be avoided if at all possible. It is essential to land the airplane the first time on a single engine approach in order to avoid the need for a go-around. Under some conditions of loading or density altitude a go-around may be impossible, and in any event the sudden application of power during single engine operation may cause control difficulties.

The handbook also included a warning regarding demonstration of V_{mc} which stated:

The engine-out minimum control speed demonstration required for the FAA flight test for multi-engine rating approaches an uncontrolled flight condition with power reduced on one engine. The demonstration should not be performed at an altitude of less than 3500 feet above 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.

The handbook did not include emergency procedures for both engines inoperative.

Aircraft information

The aircraft, serial number 30-1775, was manufactured in the US in 1968 and was first placed on the Australian Register on 29 April 1975. At the time of the accident, the aircraft had accumulated 8,725.6 hours total time since new (TTSN). The aircraft had been owned and operated by the pilot for about 10 years. A periodic (annual) inspection of the aircraft was completed on 8 December 2006, at 8,720 hours TTSN.

A review of the aircraft documentation indicated that on 20 September 1996, the approximate time the pilot purchased the aircraft, the TTSN was 7,933.7 hours. That indicated a yearly average flight time or usage of the aircraft since that time of 78 hours. A further review of Piston Engine Condition Reports¹¹ on file noted that between 17 December 1999 and 8 December 2006, a total of 536 hours had accumulated on the engines. This figure supported the average hours derived. A review of the available aircraft maintenance releases is displayed in the Table 3.

¹¹ Required to be completed about every 100 hours of engine operation.

Table 3: Maintenance release review¹²

Date issued	Aircraft hours TTSN at issue	Aircraft hours flown since last maintenance release (annually)	Notes
28 November 2002	8,418.7	48.0	No entry noting oil and filter element changed.
27 November 2001	8,370.7	90.0	No entry noting oil and filter element changed.
24 November 2000	8,280.7	98.0	Oil and filter element changed on 24 March 2001.
17 December 1999	8,182.7	N/A	No entry noting oil and filter element changed.

The maintenance releases available had correctly noted that the engine oil and oil filter element were due to be changed at 50-hourly or 4-month intervals¹³. Replacing an aircraft's engine oil was an approved pilot maintenance action for Private category aircraft and should be annotated in the Maintenance Release when that maintenance was completed. Of the four maintenance releases on file, only one showed evidence that the engine oil and filter element had been changed by the pilot.

The maximum take-off weight (MTOW) of the aircraft was 1,689.6 kg. Calculations indicated that the aircraft did not exceed the MTOW for the accident flight and was within the required centre of gravity limitations.

Engine information

The last inspection of the engines was completed on 8 December 2006 at 8,720 hours TTIS (Table 4).

Table 4: Engine information

Left engine	Right engine
Model- Lycoming IO-320-B (160 hp)	Model- Lycoming IO-320-B (160 hp)
Serial number- L3923-55A	Serial number- L3927-55A
Installed- 18 October 1974	Installed- 18 October 1974
Date of last overhaul- 1 September 1991	Date of last overhaul- 1 September 1991
Date of last maintenance- 8 December 2006	Date of last maintenance- 8 December 2006
Hours since overhaul- 1,129.0	Hours since overhaul- 1,129.0

Following the accident, both engines were disassembled and examined under the supervision of the ATSB at an approved engine overhaul facility. Examination of the

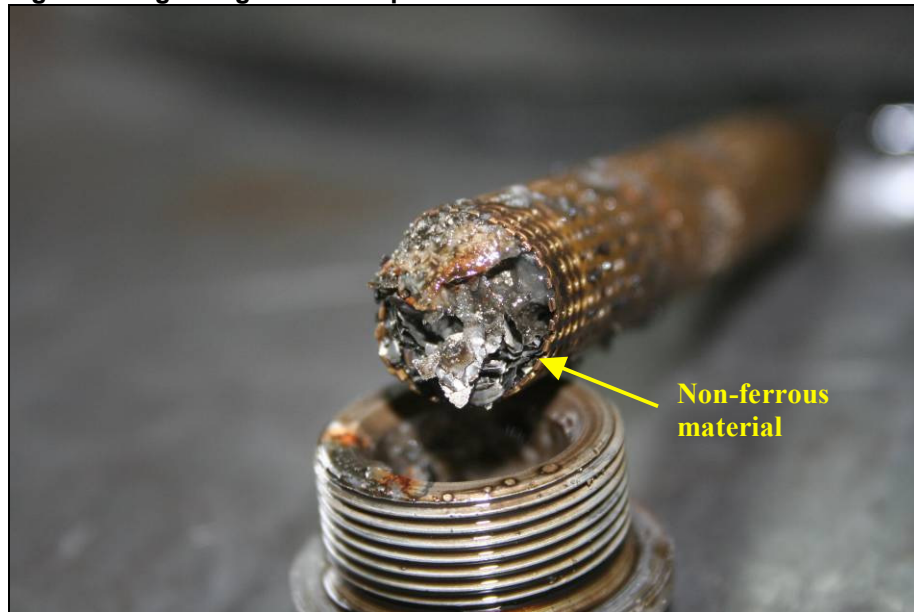
¹² Maintenance Releases on Private category aircraft were issued annually during inspection of the aircraft and were valid for a period of one year.

¹³ The most recent maintenance release was not recovered from the wreckage.

left engine did not reveal any anomalies. Examination of the right engine indicated that:

- the engine starter was found engaged into the ring gear, the position for motoring the engine
- the number-4 connecting rod crankshaft journal had surface damage
- the oil was discoloured (very dark) and had metal contamination
- the oil filter element contained normal minor non-ferrous debris
- the engine oil sump suction screen was obstructed due to metal contamination
- the material present in the suction screen was non-ferrous in nature (Figure 6).

Figure 6: Right engine oil sump suction screen



Further examination indicated that the number-4 connecting rod bearing upper insert (bearing) was damaged.

Technical examination

Several components from both the left and right engines were removed for further examination by the ATSB. The right engine sump suction screen was found to be blocked with debris consisting of a large number of small, metallic flakes, along with a substantial amount of other material¹⁴. The debris was washed from the screen and separated into like constituents. The constituents were then analysed using energy dispersive x-ray spectroscopy. The metallic flakes were found to be consistent with the aluminium-tin and lead-tin, low-friction bearing layers.

Examination of the right engine crankshaft confirmed evidence of abrasive and adhesive wear on the number-4 connecting rod journal. Oil passages, which supply oil under pressure to this area, were checked and no obstruction was found. Both upper

¹⁴ Which was later identified as sand.

and lower number-4 connecting rod crankshaft bearings exhibited wear consistent with the damage seen on the crankshaft (Figure 7).

Figure 7: Right engine number-4 connecting rod crankshaft bearing (upper)



The upper bearing half was the most severely damaged, showing substantial loss of the wear layers from the steel backing. The backing also exhibited visible plastic deformation, and material at the edges of the bearing had begun to peel away. Parts of the bearing surface on the lower bearing half had the appearance of being melted.

The oil pathways to the bearing were clear of debris, indicating no isolated oil starvation. The appearance of the right number-4 bearing and journal surface was generally indicative of a high-friction condition. However, the fact that only one bearing was affected indicated that it was likely that a general lubrication issue was not the cause and that the bearing had begun to break down independently.

The remaining crankshaft journals and bearings from both engines were found to be in good condition, exhibiting wear consistent with an engine of those operating hours.

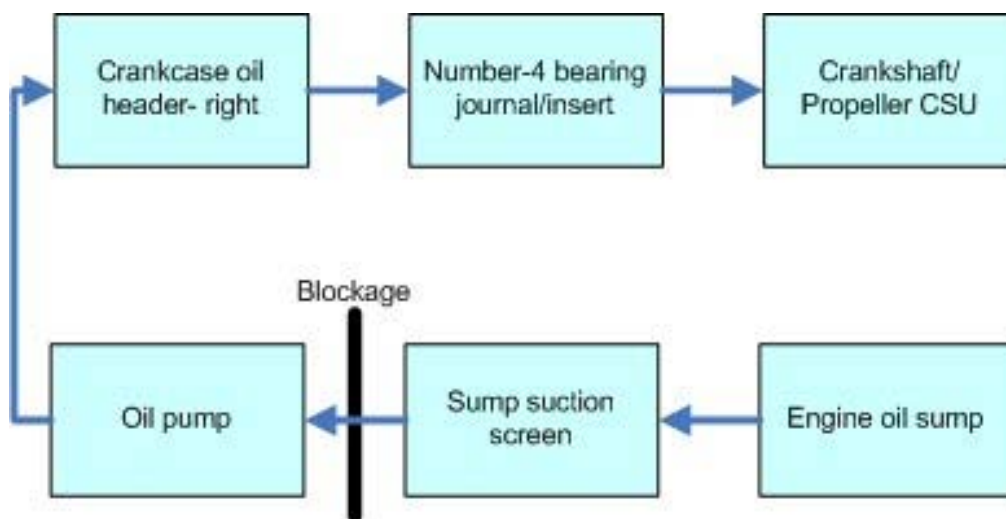
Engine lubrication flow

The engine lubrication flow diagram (Figure 8) shows that blockage of the sump screen would starve the engine oil pump of oil and result in subsequent engine damage. The sump suction screen was directly in the flow path to 'pick up' engine oil from the sump and supply that oil to the input side of the engine driven gear-type oil pump for onward delivery to the push rods, tappets, crankcase oil header, main bearings and the propeller constant speed unit (CSU)¹⁵. The CSU uses engine oil

¹⁵ Engine driven governor controlling a constant speed propeller, maintaining rotational speed by varying pitch according to airspeed and engine power.

pressure to adjust propeller pitch position during engine operation to maintain selected engine RPM. Oil starvation of the CSU would result in the propeller feathering.

Figure 8: Condensed engine lubrication flow diagram



Engine lubrication inspection requirements

The engine was being maintained in accordance with CASA maintenance schedule 5 and CASA Airworthiness Directive AD/ENG/4¹⁶. Maintenance personnel informed the investigation that during the last periodic inspection on 8 December 2006, both engines had been inspected. That inspection included the removal, inspection and replacement of the engine oil and full flow oil filter elements. According to maintenance personnel, the oil filter elements removed were unremarkable when cut open and inspected for possible metal contamination.

Maintenance personnel also reported that the owner of the aircraft had been reluctant to change oil between annual inspections. However, he had also told them that he had been replacing the oil and oil filter elements himself between those inspections.

AD/ENG/4 amdt 10, which was in effect at the time of the last inspection of the engine, included requirements for aircraft in Private and/or Aerial Work operations to comply with Appendix A of the directive. Appendix A stated:

A3 (b) Engine oil filter, oil pressure screen and suction screen inspection

All engine oil and engine oil filter replacements, including those carried out in the period between the aircraft periodic inspections, unless carried out by a pilot, shall include inspecting the engine oil pressure filter, oil pressure screen and, if applicable, the oil suction screen, for evidence of metallic particles, shavings or flakes. Take corrective action, where necessary.

¹⁶ In accordance with the directive, the engine inspections were completed about every 100 hours of engine operation.

The engine manufacturer's operator's manual annotated the requirements for 25-hourly inspection requirements as:

2. 25- *HOUR INSPECTION*. After the first twenty-five hours operating time, new, rebuilt, or newly overhauled engines should undergo a 50-hour inspection including draining and renewing lubricating oil. Engines equipped with oil pressure screen are required to comply with the following inspections after every 25 hours operating time.

a. Lubrication System (Engines equipped with Oil Pressure Screen) –

(1) Remove oil suction and oil pressure screens and check carefully for presence of metal particles that are indicative of internal engine damage. Clean and reinstall the oil suction and oil pressure screens. Drain and renew the lubrication oil.

NOTE

Change the oil at least every (4) months even if the engine has not accumulated 25 hours since the last oil change.

The engine manufacturer published a newsletter which discussed oil and filter change recommendations as below:

- A. 50-hour interval oil change and filter replacement for all engines using a full-flow oil filtration system.
- B. 25-hour interval oil change and screen cleaning for all engines employing a pressure-screen system.
- C. Even if the aircraft is flown only a few hours, a total of four months maximum between changes for both systems listed under 'A' and 'B'.¹⁷

That newsletter also discussed and provided information to assist the reader in recognising metal contamination in the engine and actions to take in the event of contamination found in the full flow filter element. For particles larger than a lead pencil point, such as those seen in the sump suction screen during the engine teardown, it suggested grounding the aircraft and removing and inspecting the suction screen.

Engine bearing deterioration

Engine bearing deterioration or distress can occur because of several factors, which are discussed in a quote below from a leading engine manual:

Infrequent oil changes cause acid build-ups in the crankcase which corrode the bearing. Six major causes of bearing distress are...dirt, lack of lubrication, misassembly, misalignment, overloading, and corrosion.¹⁸

Acidity of engine oil increases as exhaust gases are absorbed and the heat of operation causes the oil to oxidise. Corrosion can occur when acid in the engine oil collects on the bearing surfaces. Acid build-up on bearing surfaces occurs when engines sit static for prolonged periods without being operated.

¹⁷ *Lycoming Flyer Maintenance*, Lycoming A Textron Company, Williamsport, PA, USA.

¹⁸ *Sky Ranch Engineering Manual*, Second Edition, Sacramento Sky Ranch Inc., Sacramento CA, USA.

Previous Twin Comanche accident

ATSB Report BO/200102253

On 23 May 2001, a Twin Comanche aircraft, registered VH-CNZ, crashed following takeoff from Archerfield Airport, Qld. The two occupants, both pilots, were fatally injured. The instructor pilot on board had accumulated 10,213 hours total flying with 626.4 hours on type and the student pilot had accumulated 2,586 hours total flying with 120.5 hours on type. Following communications with the control tower advising of smoke from the left engine, which was believed to be from unsecured left fuel tank caps, the engine was shut down and a return to the airport attempted. While in a left turn at about 100 ft AGL, the aircraft bank increased suddenly and it descended rapidly to the ground. The aircraft impacted 55 to 60 degrees nose-down and 25 to 30 degrees left-wing low. The landing gear was down, the flaps retracted and the right engine was developing significant power. The left engine was rotating but not developing power at the time of impact. The left propeller was not in the feathered position.

The report addressed single engine performance in the aircraft as below:

The sea level single engine climb performance of light twin engine aeroplanes certified in accordance with United States Federal Aviation Regulation 23 requirements can be up to 70 to 90 percent less than the twin engine performance. Many factors can contribute to this performance loss such as aircraft age and condition, leaving the landing gear extended, not feathering a propeller, not maintaining the correct airspeed, and not turning towards the live engine.

The Analysis section of that report included this conclusion:

The flight path taken by the aircraft (the turn away from the live engine) and the aircraft configuration at impact (left propeller not feathered, landing gear extended) indicated that aspects critical to maintaining single engine performance were not accomplished. The final flight path and impact attitude of the aircraft were typical of what might be expected following loss of control when the airspeed falls below the minimum single engine control speed.

ANALYSIS

Introduction

It is acknowledged that the likelihood of an aircraft accident due to a mechanical or catastrophic engine failure is reduced when two engines are utilised, as one engine should provide sufficient power for an emergency landing.

The examination of the right engine confirmed oil blockage/obstruction internally, which would have affected propeller and engine operation. Based on the pilot's radio transmissions, the investigation determined that the right engine was most likely the first engine to stop during the flight.

Examination of the left engine did not indicate any problems that would have affected its operation and propeller blade damage confirmed the application of power at the time of impact. Given that the left engine was capable of operation, the investigation considered why the pilot was unable to maintain altitude and return to the Gold Coast Airport.

The investigation also considered the reason, after the pilot had committed to the tail wind landing on the beach, for an apparent return of power to the left engine that led to the pitch up and right bank reported by witnesses.

Right engine and propeller

The right engine oil sump suction screen was obstructed with non-ferrous bearing material, which metallurgy examination confirmed originated from the number-4 connecting crankshaft rod bearing insert.

The report by the owner-pilot having a previous problem of the uncommanded feathering of the right propeller on the previous flight was most likely the result of oil starvation to the constant speed unit as a result of the engine oil sump suction screen blockage/obstruction and a consequent momentary loss of oil pressure. The investigation could not determine the reasons for the witness reports of problems with the right engine before takeoff on previous flights.

The right engine oil and the number-4 connecting rod crankshaft bearing insert displayed evidence of overheating. Metallurgy examination indicated that the bearing wear surface was heat-affected indicating bearing distress. No blockage was found of the number-4 bearing galleys. No other bearings displayed evidence of overheating, indicating that the loss of oil pressure/lubrication did not exist long enough for internal engine damage.

A review of the aircraft operating hours over a 10-year period indicated that, on average, it was flown about 78 hours per year. The engines had been last overhauled 16 years earlier and the aircraft had not been operated on a regular basis in the ensuing years. Engine manufacturer documentation required 4-monthly oil changes regardless of operating hours. Maintenance records suggested that the engine oil had not been changed every 4 months. Reference documentation indicated that engines that are operated without regular oil changes are subject to bearing deterioration by corrosion.

The right engine propeller most likely sustained an uncommanded feathering because of a loss of oil pressure due to the sump suction screen blockage/obstruction. The right engine starter was found in a position which may indicate that the pilot was attempting to motor the engine for an attempted restart. However, the investigation could not confirm that this was the case.

Engine inspections

The requirements of the engine inspection on 8 December 2006 included the examination of the engine oil sump suction screen. The filter element had been documented as inspected during that maintenance with no anomalies noted.

The investigation could not determine how long the bearing material had been collecting in the sump suction screen.

Aircraft performance

The pilot had reported an engine failure and that he was having problems with the left engine, indicating that it was the right engine that had ceased operating initially. That, in conjunction with the evidence that the left engine was delivering power at the time of impact, led the investigation to identify any possible problems with the left engine and why the pilot was unable to complete a successful single-engine landing.

Analysis of the radar data indicated that the cruise airspeed recorded while the aircraft was outbound flying to the south and south-east may have been as high as 179 kts true airspeed (TAS). As this value was close to the aircraft manufacturer's Altitude Cruising Speed of 172 kts, that would appear to indicate that both engines were operating and both propellers were producing thrust at this point in the flight.

Following the turn to the north to return to the airport, the aircraft's ground speed increased as the effect of the south-south-easterly tail wind was felt on the aircraft's performance. The ground speed at this time was about 160 kts, equivalent to about 143 kts TAS. This speed was more than the recommended single-engine operation speed of 84 kts. However, if both engines had been operational at this time, a ground speed of about 192 kts or about 172 kts TAS should have been achievable with the tailwind.

At about 1622:10, or 2 minutes and 14 seconds after the turn, the aircraft's ground speed was about 81 kts. The last groundspeeds recorded indicated that the TAS was below the aircraft velocity minimum control speed (V_{mc}) and approaching the aircraft's aerodynamic stall speed.

Aircraft control

Witness reports indicated that as the pilot was attempting to land the aircraft, it pitched up and banked right before impacting the water. It appeared that the pilot, having problems with both engines, was attempting to complete a power off landing. Witness reports and physical evidence indicated that the left engine power resumed and increased rapidly during that approach to land. If the aircraft's TAS was below V_{mc} when the left engine power increased, the pilot would not have been able to maintain control of the aircraft. The pitch up and right bank was consistent with a loss of control due to the TAS being below V_{mc} during asymmetric flight.

The pilot had previously displayed the ability to fly the aircraft asymmetrically. However, regardless of the pilot's ability, controlled flight below V_{mc} was not possible during asymmetric flight.

The investigation could not determine why the pilot did not extend the landing gear of the aircraft prior to the emergency landing attempt. However, it may have been left stowed in an attempt to achieve maximum glide distance.

Left engine

As the investigation had established that the left engine was delivering power at the time of impact, and the disassembly inspection did not find any evidence which would result in engine failure, it considered various possibilities which may have affected the continued operation of the left engine during the flight.

Engine management

During the completion of the pilot's procedures to identify and secure the inoperative right engine, he may have inadvertently introduced a fuel or engine control related problem with the left engine, causing it to reduce power.

The Twin Comanche Owner's Handbook emergency procedures for engine failure included a requirement to retard the throttle of the suspected inoperative engine, followed by feathering the propeller and lastly moving the mixture to IDLE CUT-OFF and positioning the magnetos switches to OFF. Evidence indicated that the left engine had not been secured, as the engine magneto switches were in the ON position. Had the pilot secured the left engine, it would not have been capable of resuming power during the landing.

While it was possible that the pilot had inadvertently introduced a problem with the left engine and later identified and rectified the problem, it was considered most unlikely that the pilot would have been conducting engine troubleshooting immediately prior to the landing. At that time, he would have been more likely to be concentrating on the landing. The investigation considered it less likely that the left engine lost power because of pilot mismanagement.

Fuel management

The Twin Comanche Owner's Handbook stated that the main fuel tanks should be selected for all phases of flight other than level flight. The wreckage examination confirmed that selection. Calculations of fuel used since the last refuelling of the aircraft indicated that about 119 L of fuel should have remained in the aircraft at the time of the accident. Because of the fuselage disruption, immersion in water, and recovery efforts, the amount of fuel collected from the intact fuel tanks post-impact may not have reflected the amount of fuel pre-impact.

The investigation was unable to test the quality of the recovered fuel due to seawater contamination. However, there were no reports, by operators of other aircraft that had been refuelled from the same source, to indicate that fuel quality may have been a factor in the accident. There were no abnormalities found within the fuel system installation that would have prevented or limited, the normal operation of the engines.

The investigation could not discount the possibility that a low fuel level in the left main tank may have led to temporary fuel starvation of the left engine as a result of unporting¹⁹ of the fuel pick up in the left main tank. If the fuel flow had been interrupted and then resumed, due to aircraft movement about its axes, the sudden increase in thrust from the left propeller could have led to the pitch up and sharp right bank reported by witnesses.

Pilot decision making

The investigation could find no evidence to indicate that maintenance personnel had been requested to conduct a thorough examination of the engine after the reported problem during the flight from Bundaberg to the Gold Coast Airport. It was likely that the pilot would have conducted a ground run of the engine in question prior to flying the aircraft on the accident flight. It appeared that the purpose of the check flight was to confirm the serviceability of the right engine and propeller. His decision to conduct the flight without engineering inspection or advice increased the possibility of experiencing problems during any subsequent flights.

¹⁹ Flying in turbulence or in an unbalanced flight state associated with asymmetric flight with a low fuel state can lead to uncovering of the fuel outlets in the fuel tanks. This is referred to as unporting.

FINDINGS

Contributing safety factors

- The right engine number-4 connecting rod crankshaft bearing lost wear layers from the steel backing as a result of deterioration.
- The right engine oil suction sump screen became obstructed with bearing material from the number-4 connecting rod crankshaft bearing.
- The right engine sustained a loss of oil pressure as a result of the engine oil suction sump screen obstruction resulting in uncommanded feathering of the right propeller.
- During cruise flight, the right propeller feathered with the associated loss of thrust.
- During cruise flight, the left engine sustained an apparent power loss.
- The pilot did not secure the left engine following the power loss.
- Asymmetric thrust below velocity minimum control speed (V_{mc}) resulted in loss of control following the resumption of power to the left engine during the emergency landing.

Other safety factors

- The pilot did not seek an engineering inspection or advice, following an apparent malfunction of the right engine, before conducting the check flight.
- Aircraft documentation indicated that the aircraft engine oil had not been changed by the owner-pilot in accordance with the engine manufacturer's requirements.

APPENDIX

Radar data for the last 3 minutes of the flight

Time	Altitude in ft AMSL	Groundspeed in kts.
1620 :56	1,500	162.4
1621:01	1,600	160.9
1621:06	1,500	162.6
1621:11	1,500	163.0
1621:15	1,500	162.9
1621:20	1,500	163.0
1621:25	1,500	159.5
1621:30	1,500	154.9
1621:35	1,500	141.55
1621:40	1,400	137.1
1621:45	1,400	132.4
1621:50	1,300	125.3
1621:55	1,300	111.2
1622:00	1,200	110.9
1622:05	1,200	106.4
1622:10	1,100	101.9
1622:15	1,100	100.1
1622:20	1,000	99.1
1622:25	1,000	97.4
1622:30	900	95.6
1622:35	800	97.2
1622:40	800	95.4
1622:45	700	91.7
1622:50	600	94.0
1622:55	500	93.2
1623:00	500	93.5
1623:05	400	92.5
1623:10	400	92.4
1623:15	300	92.2
1623:20	200	91.4
1623:25	200	90.6
1623:30	200	88.6
1623:35	200	89.6
1623:40	200	89.6