Australian Government
Australian Transport Safety Bureau

Engine power loss involving Piper Cherokee Six, VH-TSZ

Jandakot Airport, Western Australia | 23 November 2012

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

Addendum

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Safety summary

What happened

VH-TSZ accident site

Source: ATSB

On the morning of 23 November 2012, the pilot of a Piper Cherokee Six, registered VH-TSZ, with two other owner-pilots on board, took off from runway 24L at Jandakot Airport, Western Australia. After turning onto the track to Beverley and at about 700 ft above ground level, the engine lost power. The pilot immediately turned the aircraft towards runway 30 and focussed on flying the aircraft while the owner-pilot in the copilot seat conducted some of the troubleshooting checks. The engine did not regain power.

With insufficient height and speed to reach the runway, the pilot force landed the aircraft into wooded bushland within the airport precinct, approximately 150 m short of a cleared area in the undershoot of runway 30. The aircraft was substantially damaged by impact with trees. The occupants exited the aircraft with only a minor injury to one passenger.

What the ATSB found

The ATSB found no mechanical defects or fuel supply anomalies that would have prevented normal engine operation. The evidence for carburettor icing was equivocal and therefore, could not be ruled out as a contributing factor. No other likely contributing factors were identified.

It was also found that the pilot did not ensure all of the available procedures for an engine power loss and power-off landing were followed, which resulted in reduced gliding performance and a higher-than-necessary landing speed.

The pilot had not completed a flight review in the 2 years prior to the occurrence, increasing the operational risks including the response to emergency situations.

Safety message

The conduct of emergency procedures relies on the application of established knowledge and skills, reinforced by the use of a pre-take-off emergency briefing, and conduct of flight reviews. By not complying with the periodic flight review requirements, the pilot missed an opportunity to maintain those critical skills.

Contents

The occurrence

On the morning of 23 November 2012, three of the four owner-pilots of a Piper Cherokee Six, registered VH-TSZ, arrived at Jandakot Airport, Western Australia at around 0800 Western Standard Time[1] for a private flight to Beverley. This was a weekly flight to participate in gliding activities at Beverley and was conducted under the visual flight rules.

The owners conducted a daily inspection, including fuel drains from the main tanks. The designated pilot reported that the main tanks were full (about 90 L in each), the wingtip fuel tanks were empty and the taxi and takeoff was conducted with the fuel selector in the left main tank position.

The trio boarded the aircraft and at 0807 the pilot reported to the ground controller that he was ready to taxi from the south-western apron to the run-up bay near the threshold of runway 24, which was at the opposite end of the airport. At the run-up bay the pilot completed the pre-take-off and engine run-up checks, including a functional test of the carburettor heat system.

At 0817 the pilot was cleared for takeoff on runway 24 left. The takeoff proceeded normally and at about 500 ft above ground level (AGL) the pilot retracted the flaps, switched the auxiliary fuel pump off, set climb power to 25 inches of manifold pressure and 2,500 RPM and turned left to intercept the departure track. After completing the turn and while climbing through about 700 ft, the engine spluttered and coughed several times then suddenly lost power. All aboard recalled later that they thought the engine continued to run or windmill at about idle power.

The pilot immediately turned towards runway 30 and focused on flying the aircraft. The owner-pilot in the copilot seat asked the pilot to switch on the auxiliary fuel pump and then changed the fuel selector from the left main tank position to the right main tank position.

The aerodrome controller (ADC) twice requested the pilot to confirm operations were normal but received no response. This was due to the workload in the cockpit at the time. The ADC then broadcast a general clearance to land on any runway and suggested runway 30.

The owner-pilot in the copilot seat also manipulated the throttle by ensuring it was all the way in (full throttle) to try and restore engine power. The owner-pilot seated in the second row assisted the pilot by monitoring the aircraft stall warning light. The pilot stated he was maintaining about 40 kt (indicated airspeed). The other occupants thought that the speed might have been higher than this figure because of the lack of any stall warning. Carburettor heat was not selected at any time during the troubleshooting of the power loss.

Engine power was not restored, and with insufficient height and speed to reach the runway or the cleared undershoot area, the pilot advised the passengers that ‘we’re going into the trees’. The owner-pilot in the copilot seat attempted to turn the fuel selector to the OFF position. No wing flap was selected prior to landing.

The aircraft collided with several trees, initially removing the right wingtip and then successively the right wing and nose landing gear. The aircraft then slewed right and came to rest approximately 45 m from the initial tree impact point (Figure 1). The occupants immediately evacuated the aircraft and retreated to a safe distance.

When it became evident that there was no post-impact fire, one occupant returned to the aircraft and ensured the battery master switch, magneto switches and fuel selector were all off.

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

Figure 1: VH-TSZ, looking back along the wreckage trail

Source: ATSB

Context

Pilot information

The pilot held a Private Pilot (Aeroplane) Licence issued in 1997 and a current Class 2 Medical Certificate. He was endorsed on single-engine aircraft below 5,700 kg maximum take-off weight, including those with constant speed propellers. That was sufficient to act as pilot of a Cherokee Six. At the time of the accident he had accrued 556 hours total flying experience with 46 hours on type. The pilot was also an experienced glider pilot.

The pilot's last periodic flight review was conducted on 29 May 2010 in VH-TSZ. This placed the pilot's review about 6 months overdue for renewal.

Aircraft examination and tests

The Australian Transport Safety Bureau conducted an on-site examination of the aircraft. All flight, engine and fuel controls were found to be free of pre-impact defects. The aircraft was then removed from site and the examinations continued in a nearby hangar. Several components including the carburettor and the carburettor temperature indicating system were removed for further examination. The magnetos, magneto leads and spark plugs were checked for continuity and a timing check carried out with no anomalies. The fuel system filters were inspected and found free of water and contaminants. The fuel delivery system from the left main tank to the carburettor was functionally checked with no fault found. The fuel selector was disassembled and the changeover spring and ball system inspected for correct function at each selection. The remaining examinations found no pre-existing defects with the airframe, engine or auxiliary systems that may have contributed to the power loss.

Weather and icing probability

The weather at the time of departure was fine with about half of the total visible sky covered with cloud at 1,040 m (3,400 ft) AGL, an outside air temperature of 19.8 °C, a dewpoint[2] of 11.2 °C, and a 13 kt (24 km/h) south-westerly wind.

The temperatures were plotted on an icing probability chart (Appendix A) with a calculated dewpoint depression[3] of 8.6 °C and a relative humidity of approximately 60 per cent. The charted intersection of these values placed the icing probability in the region of 'moderate icing – cruise power, serious icing – descent power'.

All of the owner-pilots related that the aircraft had a history of being particularly prone to carburettor icing and this manifested most at climb and descent power settings. One owner related that it was more susceptible to carburettor icing than the icing probability chart predicted.

The owners stated that carburettor icing in the aircraft was almost always preceded by cues such as a drop in manifold pressure and RPM or starting to run rough and that selection of carburettor heat rectified the problem on those occasions. They also stated that, in their opinion, the carburettor temperature gauge was very reliable and carburettor heat was applied when the indication warranted. On the incident flight, it was reported that there were no prior symptoms or temperature indications that they could attribute to carburettor icing.

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2 Dewpoint is the temperature at which water vapour in the air starts to condense as the air cools. It is used, among other things, to monitor the risk of aircraft carburettor icing or likelihood of fog at an aerodrome.

3 Dewpoint depression is derived by subtracting the dewpoint temperature from the outside air temperature.

Emergency procedures

The *Aircraft Flight Manual* and the *Owner's Handbook* for this aircraft serial number did not include any emergency procedures. A checklist was carried in the aircraft that reflected the procedures provided by the aircraft manufacturer for a later serial number Cherokee Six with equivalent systems and performance.

The checklist included procedures for 'engine power loss during takeoff', 'engine power loss in flight', and 'power off landing'. Specified speeds ranged from 'maintain safe airspeed' for the after-takeoff scenario, to 77 kt for a power-off landing, then to 87 kt glide speed in flight.

The pilot stated that after the engine power loss he targeted a speed as low as possible at around 40 kt and maintained that speed for the duration of the glide. In contrast, the *Owner's Handbook* listed a flaps-up stall speed of 61kt.

Although activation of carburettor heat was specified in both engine power loss procedures, it was not activated because the pilot and other front seat occupant did not think it was necessary in the limited time available.

For a power-off landing the checklist specified that 'Touchdowns should normally be made at [the] lowest possible airspeed with full flaps'.

Safety analysis

Introduction

In this occurrence, the aircraft sustained a sudden engine power loss shortly after takeoff resulting in a forced landing in wooded terrain and significant damage to the aircraft structure. The aircraft occupants survived the impact with only minor injuries. Given the nature of the event, the Australian Transport Safety Bureau (ATSB) concentrated on the airworthiness and operational aspects that could have contributed to the accident.

Engine power loss

The ATSB considered engine malfunction, fuel problems or carburettor icing as possible factors contributing to the engine power loss. The on-site examination and component testing found no defects or anomalies with the aircraft engine or ancillary systems that would have precluded normal operation. The main fuel tanks were likely full at start-up with no contamination evident, and there was no evidence that the left main tank was not selected for start. Even in the event of a mis-selection, there was probably insufficient fuel in the tip tanks to sustain engine operation throughout the pre-take-off and take-off phases. Furthermore, the right main fuel tank was selected in response to the engine power loss but to no effect. Based on the available evidence, the ATSB does not consider that a problem with the fuel or fuel system was a factor in the engine power loss.

In considering carburettor icing, the ATSB found that the evidence was equivocal. Supporting the formation of carburettor icing were environmental conditions conducive to some degree of icing. Furthermore, the aircraft was reported to be susceptible to icing at all engine power settings, including high power. Also consistent with carburettor icing was the report from the aircraft occupants that the engine continued to operate at about idle power, indicative of a possible induction restriction as a result of ice accretion.

However, the nature of the sudden power loss was atypical of carburettor icing symptoms previously experienced in this aircraft, and the carburettor temperature indication at that time was reported to be outside the icing range. In respect of the validity of the carburettor temperature indication, the ATSB found that the gauge calibration was correct and this correlated with the owner-pilots' experience in the aircraft. That information was taken in the context of the unit not being approved for use on type-certified aircraft, adding some uncertainty regarding the significance of the carburettor temperature indication. Given the equivocal evidence and that carburettor heat was not selected after the engine power loss, carburettor icing could not be discounted as a factor.

Operational considerations

The ATSB identified several anomalies in the operation of the aircraft in response to the engine power loss: no application of carburettor heat, no flaps applied for landing, and slower than specified glide speed. Although the *Aircraft Flight Manual* and *Owner's Handbook* did not specify engine power loss procedures or a glide speed, a checklist was available to the pilot that included emergency procedures and was consistent with manufacturer recommendations for aircraft of this general type.

Given the limited time available to the pilot to plan and conduct the forced landing, and lack of apparent precursors, the non-application of carburettor heat is understandable. However, it is advisable to follow all prescribed engine power loss procedures consistently, including the use of carburettor heat as applicable, to maximise the opportunities to restore engine power and avoid an off-airport landing.

The extension of wing flaps during a glide approach has the effect of lowering the stall speed and steepening the angle of descent with an increase in drag. As such, flaps are not usually extended in a glide approach where range is important, but are extended for a forced landing to reduce the energy of any impacts. On this occasion, the non-use of wing flaps in the final stages of the glide resulted in a higher-than-necessary landing speed with its associated risk of injury.

The glide speed targeted by the pilot was substantially less than any of the speeds nominated in the onboard checklist and would have reduced the glide range. Furthermore, flying at less than the optimum airspeed increases the risk of stall, and reduces the energy available to arrest the descent prior to landing. In this case, there was insufficient information to establish the influence of the lower-than-specified glide speed on the outcome.

In response to the sudden loss of engine power soon after takeoff, the pilot maintained control of the aircraft and the forced landing did not result in serious injuries. However, there were some anomalies in the operation of the aircraft during the emergency. Pilot proficiency in the conduct of emergency procedures is reliant on established knowledge and skills, reinforced by the use of a pre-take-off emergency briefing, and conduct of flight reviews. By not complying with the periodic flight review requirements, the pilot missed an opportunity to maintain these critical skills. That increased risk, but was not necessarily a factor in the final outcome.

Findings

From the evidence available, the following findings are made with respect to the engine power loss involving Piper Cherokee Six, registered VH-TSZ, that occurred at Jandakot Airport, Western Australia on 23 November 2012 and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing safety factor

- Shortly after takeoff and at a low altitude, the aircraft had a significant and sustained engine power loss that necessitated a forced landing.

Other safety factors

- The pilot did not ensure all of the available procedures for an engine power loss and power-off landing were followed, resulting in reduced gliding performance and higher-than-necessary landing speed.
- The pilot had not completed a flight review in the 2 years prior to the occurrence, which increased operational risk, including in the response to the emergency.

Other key finding

- The presence of an ice build-up in the carburettor leading to blockage of air supply and sudden loss of engine power could not be ruled out as a contributing factor.

General details

Occurrence details

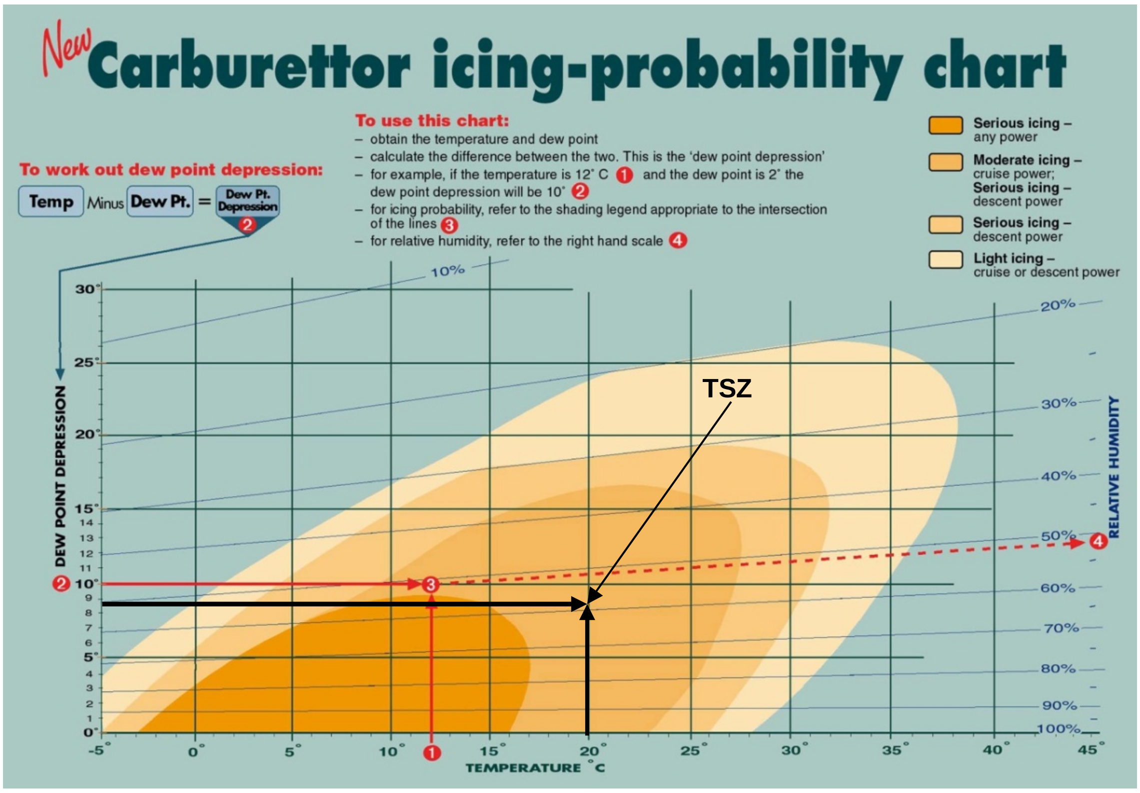
Date and time:	23 November 2012 – 0815 WST	
Occurrence category:	Accident	
Primary occurrence type:	Engine power loss	
Type of operation:	Private	
Location:	Jandakot Airport, WA	
	Longitude: S 32° 05.85’	Latitude: E 115° 52.87’

Aircraft

Manufacturer and model:	Piper Aircraft Corp. PA32-260 (Cherokee Six)	
Registration:	VH-TSZ	
Operator:	Owners	
Serial number:	32-601	
Type of operation:	Private	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – nil injuries	Passengers – 1 minor, 1 nil injuries
Damage:	Substantial	

Appendices

Appendix A – TSZ carburettor icing probability at departure



Sources and submissions

Sources of information

The sources of information during the investigation included the:

- pilot and the other owner-pilots of the aircraft
- aircraft manufacturer
- Airservices Australia (Airservices).

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 pilot and the other owner-pilots of the aircraft, the Civil Aviation Safety Authority (CASA) and Airservices.

Submissions were received on behalf of the pilot and the other owner-pilots of the aircraft and from CASA. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

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 action 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.

Australian Transport Safety Bureau

24 Hours 1800 020 616
Web www.atsb.gov.au
Twitter @ATSBinfo
Email atsbinfo@atsb.gov.au

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