Australian Government
Australian Transport Safety Bureau

Publication Date: March 2009 ISBN 978-1-921602-24-5

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2008-022
Final

Ditching – Brampton Island – 03 April 2008

INFRA-08431

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Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Abstract

On 3 April 2008, a Piper PA-32-300 Cherokee Six aircraft, registered VH-ZMP, lost engine power shortly after takeoff from Brampton Island, Qld and ditched into the sea. The pilot and the four passengers evacuated the aircraft before it sank and were later recovered by rescue helicopter. The engine power loss was consistent with fuel starvation.

Following the event, the aircraft operator amended Cherokee Six fuel procedures to require a minimum of 30 L of fuel in the selected fuel tank for any take off.

FACTUAL INFORMATION

Sequence of events

On 3 April 2008, a Piper PA-32-300 Cherokee Six aircraft, registered VH-ZMP, took off from Brampton Island, Qld under the visual flight rules (VFR) for a charter flight to Mackay, with a pilot and four passengers on board. This was the sixth flight since the aircraft had been refuelled. When climbing through approximately 400 ft, the engine surged and lost power. The pilot turned the aircraft left approximately 30 degrees to face into the wind and to be parallel with the wave tops on the sea below and ditched the aircraft between Brampton Island and Carlisle Island.

The aircraft decelerated rapidly on contact with the water, came to rest afloat in an upright position and remained afloat for about 1 minute. All of the occupants evacuated the aircraft and were later recovered by a rescue helicopter. On 11 April, the aircraft was recovered from the sea bed. Once the aircraft was lifted from the sea, a significant quantity of fuel drained from the right main fuel tank. The tip tanks had been damaged and that prevented any assessment of the fuel quantity in those tanks at the time of ditching. No mechanical defect was found with the aircraft systems that may have contributed to the engine power loss.

Before ditching, the pilot attempted to regain power by manipulating the throttle and mixture, and switching on the electric fuel pump. The pilot transmitted a MAYDAY[1] broadcast, opened the front door (Figure 1), instructed the passengers in row 3 to open the rear door, assessed the best direction for a ditching, turned the aircraft in that direction, and 'conducted a normal landing' approach until contact with the water.

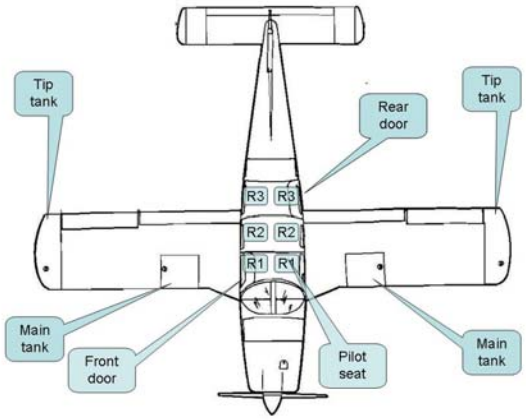
The pilot reported that after the engine power loss, the fuel tank selection was not changed and the flaps were not extended prior to contact with the water.

The pilot sustained a soft tissue injury to one eye from an impact with the glare shield during the deceleration. The passengers in row 2 stated that their forward movement was largely cushioned by a powerful rearward inrush of water from the forward edge of the front door, which was ajar at the time. The passenger in the left seat of row 3, adjacent to the rear door, described a similar effect from the inrush of water from the forward edge of the rear door. The passenger in the right seat of row 3 was not in line with a door, and did not experience this effect. This passenger reported that a large suitcase that was unsecured behind the row 3 seats moved forward on top of the passenger, pushing the passenger down over the lap belt. This passenger stated that it was then difficult to release the lap belt while being held down by the weight of the suitcase and that, once the lap belt had been released, the suitcase also obstructed the exit route, leaving little time to vacate the aircraft before it sank. This passenger

1 International radio call for urgent assistance.

was the only occupant to sustain bone fractures as a result of the ditching.

Figure 1: Plan view of aircraft



Prior to the flight, all the occupants were fitted with a life jacket that was folded in a pouch around their waist and which they all successfully donned and inflated after vacating the aircraft.

Pilot information

The pilot held a valid Commercial Pilot (Aeroplane) Licence with a Class 1 medical certificate that was valid until 15 November 2008. The pilot had a total of approximately 543 hours aeronautical experience, including approximately 7 hours on Cherokee Six aircraft. The pilot had recently started working with the company and had undergone company induction and familiarisation training, including a simulated engine failure and ditching after takeoff from Brampton Island.

Fuel system

The aircraft had an inner fuel tank and an outer fuel tank in each wing. Each fuel tank independently fed a fuel selector. Fuel was then fed from the selector via an electric fuel pump and an engine driven fuel pump in series to the engine fuel injection system. The fuel selector control (Figure 2) was located at floor level under the centre of the instrument panel and had 5 settings. From left to right, the settings were OFF, LEFT TIP, LEFT MAIN, RIGHT MAIN and RIGHT TIP. Selection of the OFF setting also required movement of a sprung interlock to prevent inadvertent selection. Positive sprung detents for each selection in the fuel selector valve also provided tactile sensation to the pilot indicating that a proper selection had been made. The tip tanks had a usable fuel capacity of 64 L each, and the main tanks had a usable fuel capacity of 94 L each.

Figure 2: Fuel selector

Fuel system operation

The Cherokee Six 300 pilot's operating manual stated that fuel should be distributed equally between each side of the aircraft. It further stated that the tip tanks should always be filled first, and fuel from the main tanks should be used first.

The pilot's operating manual contained a detailed procedure for conducting fuel drain checks after refuelling. However, as the accident flight was the sixth flight since the aircraft had last been refuelled, it was considered unlikely for any issue relating to refuelling and fuel drain checks to have been a factor in the accident sequence.

The pilot's operating manual procedure for changing the fuel tank selection in flight required the pilot to switch on the electric fuel pump before the tank selection was changed to ensure a constant fuel flow to the engine. However, the sequence was different in the event of suspected fuel starvation leading to a power loss. In that case, the pilot was required to change the fuel tank selection before switching on the electric fuel pump, to reduce the likelihood of purging the fuel lines with air from the empty fuel tank.

The operating instructions in the pilot's operating manual also provided a list of ten 'highly recommended fuel operating procedures' that had been designed to minimise the likelihood of fuel starvation. Among these procedures was a recommendation that takeoff and landing should be conducted with the fuel selector selected to the tank with the most fuel.

Aircraft operator fuel management policy

The Cherokee Six aircraft type has been used for many years to provide a charter service to the Whitsunday Islands, including similar flights to those conducted before the accident.

There were sufficient landing sites in the vicinity of the Whitsunday Islands to allow a wide range of different flight routes, and while the aircraft was flown regularly over the individual legs of the flight sequence since the last refuelling (Figure 3), it would rarely have flown that particular flight sequence. The nature of operations in that area was characterised by numerous short legs. This could lead to greater opportunity for variability of flight time and fuel consumption for any given fuel load. The operator's fuel management policy was to use the tip tanks for flight fuel[2] and to use the main tanks for reserve fuel. Sixty litres of reserve fuel was distributed equally across the two main tanks and both tip tanks were normally filled at Mackay for flight fuel as a standard procedure. The aircraft operator also used a standard procedure for fuel tank selection to ensure even fuel usage. The procedure stated:

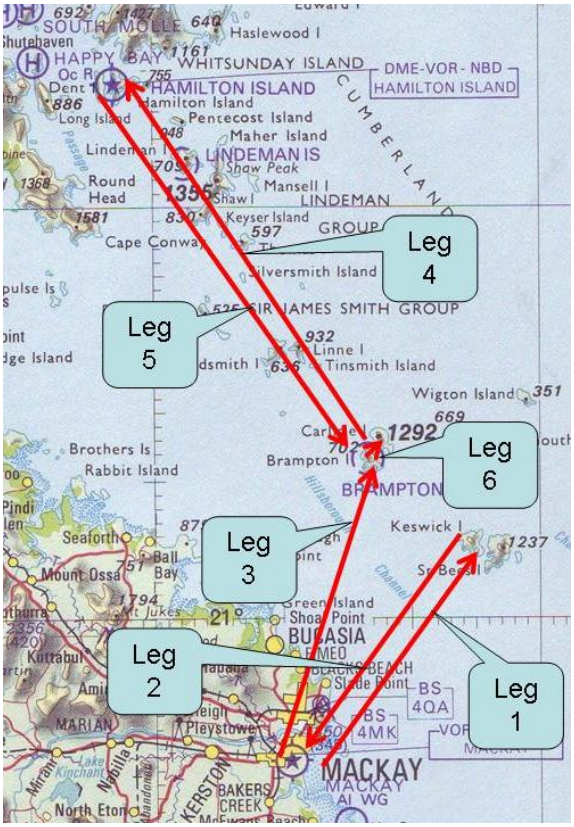
> As standard procedure to avert any confusion, left tank (L for Leaving) is to be used on flights outbound from Mackay and right tank (R for Returning) is to be used on flights inbound to Mackay from Brampton and Keswick Island.

The operator's pilots stated that it was standard procedure to change fuel tank selection from one tip tank to the other between each flight.

The fuel management policy stated that the following standard fuel consumptions were to be used for planning purposes for the following regular flights.

- Mackay airport to Keswick Island - 15 L
- Mackay airport to Brampton Island - 15 L
- Keswick Island to Brampton Island - 10 L
- Keswick Island or Brampton Island to Hamilton Island - 30 L.

Figure 3: Legs flown since last refuelling



The pilot had flown all the flights since the aircraft had been last refuelled and stated that the first leg was flown on the left tip tank and that the aircraft fuel tank selector was changed to the opposite tip tank after landing before shut down at the end of each leg. Fuel tank selection was not changed again until the end of the next leg.

Since refuelling, the aircraft had been flown from:

- Mackay to Keswick Island and return
- Mackay to Brampton Island
- Brampton Island to Hamilton Island and return.

The next leg was intended to fly to Mackay, and to be the last leg before refuelling again at Mackay. Correct fuel tank selection would have meant that this flight should have been flown using fuel from the right tip tank. The fuel tank selector was found in the right main tank position when the aircraft had been recovered from the sea. However, it was possible that the fuel selector had been inadvertently moved from the right tip tank position during the evacuation by one of the three occupants who vacated the aircraft through the front right door.

2 In this context, flight fuel is fuel sufficient for the planned flight from departure to destination, to an alternate if required and holding fuel if required. It does not include any reserve fuel.

Based on both tip tanks having been filled to 64 L, the following table depicts the fuel remaining in each tip tank at the start of each flight since the aircraft was last refuelled, on the basis of standard planned fuel consumption.

Table 1: Flight fuel remaining at takeoff for each leg on the basis of aircraft operator procedures

Leg	From	To	Left tip tank (litres)	Right tip tank (litres)
1	Mackay Airport	Keswick Island	64	64
2	Keswick Island	Mackay Airport	49	64
3	Mackay Airport	Brampton Island	49	49
4	Brampton Island	Hamilton Island	19	49
5	Hamilton Island	Brampton Island	19	19
6	Brampton Island	Mackay Airport	4	19

The actual flight times since the aircraft's last refuel could not be ascertained, but recent average flight times taken for the specific sectors were assessed from previous flight logs to provide an estimate of the flight time. Pilots stated that the engine power settings were configured in the cruise to consume approximately 16 US gallons, or 60 litres per hour.

ANALYSIS

Technical inspection of the engine after the accident did not reveal any defect that could have led to the power loss. The reported nature of the power loss was consistent with an interruption to the fuel supply to the engine. Flight fuel was normally carried in the tip tanks, and reserve fuel was carried in the main tanks. There was sufficient fuel to complete the flight in the main tanks. However, if the fuel selections during the previous legs had been made in accordance with the pilot's recollection, the fuel supply to the engine would have been selected from the right tip tank.

Using a fuel allowance of 5 L per leg for taxi, takeoff, climb, circuit and landing, and average flight times based on previous flight logs, the aircraft would have probably used about 108 L of flight fuel soon after takeoff from Brampton Island on the sixth leg, and the remaining flight fuel would have been consumed around the time of landing at Mackay. Operational variations based on previous flight logs indicated that up to 128 L of flight fuel may have been occasionally consumed during repeated operation of the same flight sequence since the previous refuelling. Both the company fuel management policy and an assessment of recent flight records indicated that the aircraft should have had sufficient flight fuel to complete the flight, albeit with little flight fuel remaining. The quantity of fuel remaining in the selected tank could have been affected by increased fuel flow or increased flight durations or incorrect fuel tank selection. While it is not possible to determine which of these factors might have contributed to the aircraft's fuel state at the time of the power loss, any of them, possibly in combination, could have reduced the margin between available fuel in the tip tanks and fuel used. It is likely that the engine was operating on the right tip tank at that time. As such, given the nature of the power loss and in particular the reported engine surging, it is likely that the fuel in the right tip tank was exhausted, leading to the power interruption.

Reserve fuel would not have been immediately available in the event of fuel exhaustion from a selected fuel tank because of the delays inherent in resuming fuel flow from another tank once the fuel lines had been purged of fuel.

The fuel supply had not been selected from the tank with the greatest quantity of fuel as recommended in the pilot's operating manual. This was not a requirement under the company's operating procedures.

Following the power loss, the pilot switched on the electric fuel pump, but did not change the fuel tank selection. Given the limited time available between the power loss and impending ditching, it was considered likely that even if the correct fuel management actions had been taken, engine power would not have been restored in time to prevent the ditching.

The pilot's recent induction and familiarisation training would have provided a greater level of skill and familiarity with the necessary procedures to be undertaken in the short time available

between power loss and ditching, and the need for the pilot to complete other tasks.

FINDINGS

From the evidence available, the following findings are made with respect to the ditching at Brampton Island, and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing Safety Factors

- The aircraft operator's procedures required that reserve fuel be kept in a separate fuel tank from flight fuel. [*Safety Issue*].

Other safety factors

- Turning on the fuel pump before changing from an empty fuel tank would delay recovery of fuel flow to the engine and restoration of engine power.

Other key findings

- Following the engine power loss, the pilot prioritised tasks to minimise the risk to the occupants in the short time available.

SAFETY ACTION

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Aircraft operator

Safety Issue

The aircraft operator's procedures required that reserve fuel be kept in a separate fuel tank from flight fuel.

Action taken by operator

The aircraft operator has advised the Australian Transport Safety Bureau that it has changed the fuel management procedures for Cherokee Six operations based at Mackay. The changed procedures are designed to ensure that there is a minimum of 30 L of fuel in the selected fuel tank for any takeoff.

SOURCES AND SUBMISSIONS

Sources of information

Pilot of VH-ZMP

Aircraft operator

Civil Aviation Safety Authority

Submissions

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

A draft of this report was provided to the pilot of the aircraft, aircraft operator and the Civil Aviation Safety Authority (CASA). Submissions were received from CASA, and the aircraft operator. The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.