Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation – AO-2007-007
Final

Engine failure and ditching near Warraber Island, Torres Strait 23 May 2007

VH-PYD

Piper Aircraft Inc. PA-32-260, Cherokee Six

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Engine failure and ditching near Warraber Island, Torres Strait – 23 May 2007 – VH-PYD Piper Aircraft Inc. PA-32-260, Cherokee Six

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Figure 1: Google - Map data from Google Maps (http://maps.google.com.au).

Abstract

At about 1030 Eastern Standard Time on 23 May 2007, a Piper Aircraft Inc. PA-32-260 aircraft, registered VH-PYD (PYD), departed Horn Island, Queensland, for a visual flight rules charter flight to Warraber Island, Queensland, with the pilot and three passengers onboard. Approximately 25 NM from Warraber Island, the aircraft experienced difficulties with the powerplant and was forced to ditch into the waters of the Torres Strait. Having received only minor injuries, the occupants exited the aircraft before it sank. The occupants were located and rescued within an hour of the ditching.

Shortly after commencing the descent into Warraber Island, the pilot noticed that the engine speed had increased beyond the normal range. Several unsuccessful attempts were made to reduce the engine speed, and within a short time the engine stopped producing power. Without engine power, the aircraft was not able to maintain altitude and given the aircraft's distance from land was forced to ditch into the water.

Because the aircraft was not recovered, the factors that resulted in the powerplant failure could not be determined; however it was probable that they were related to a problem with the forward most crankshaft bearing.

In addition to the favourable sea, the pilot's recently acquired knowledge from the company's emergency procedures training likely contributed to the successful ditching.

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.

About ATSB investigation reports: How investigation reports are organised and definitions of terms used in ATSB reports, such as safety factor, contributing safety factor and safety issue, are provided on the ATSB web site www.atsb.gov.au.

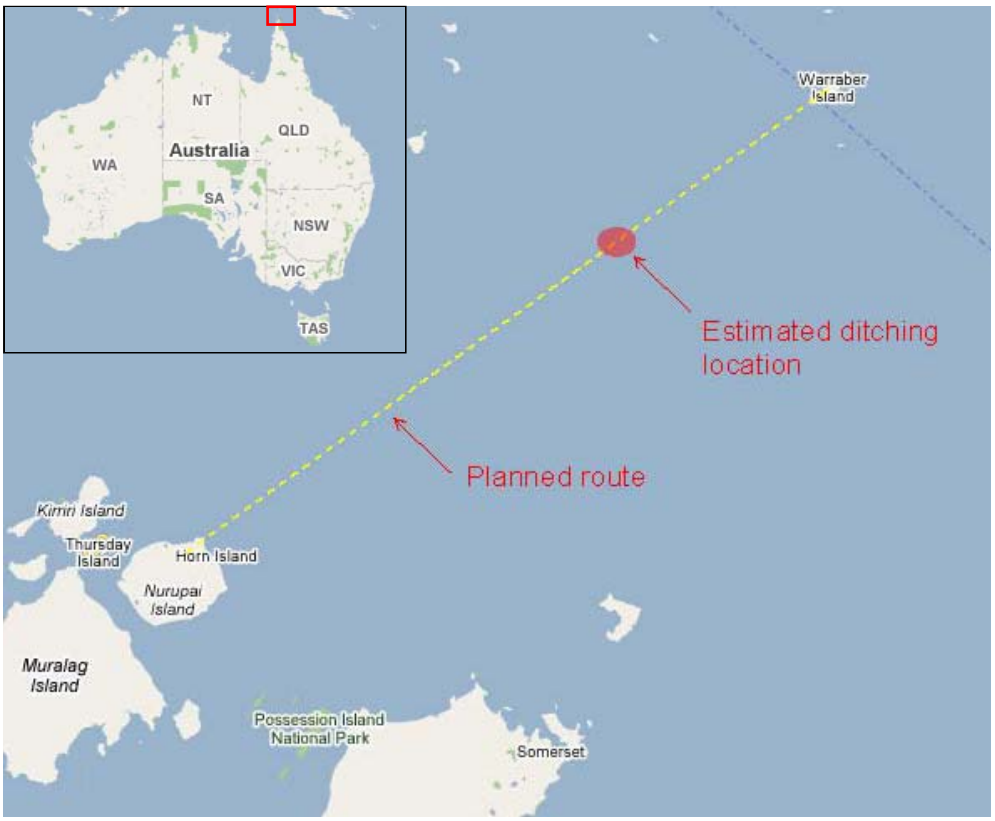
FACTUAL INFORMATION

The Australian Transport Safety Bureau (ATSB) did not conduct an on-site investigation for this occurrence. The factual information contained in this report is based upon information reported to the ATSB by persons involved in the occurrence and involved in the operation of the aircraft.

History of the flight

At about 1030 Eastern Standard Time[1] on 23 May 2007, a Piper Aircraft Inc. PA-32-260 aircraft, registered VH-PYD (PYD), departed Horn Island, Queensland, for a visual flight rules charter flight to Warraber Island, Queensland, with the pilot and three passengers onboard (Figure 1). Approximately 25 NM from Warraber Island, the pilot reported difficulties with the engine and was forced to ditch into the waters of Torres Strait. Having received only minor injuries, the occupants exited the aircraft before it sank and were located and rescued within an hour of the ditching.

Figure 1: Approximate location of ditching



Source: Google Maps (http://maps.google.com.au/)

The flight was the second of the day for the pilot in command in PYD. The pilot reported that he had completed the daily inspection prior to the first flight. During this inspection the pilot determined that there was approximately 200 litres of fuel

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

onboard, that it was free of water contamination and that there was about 9 US quarts (8.5 litres) of engine oil,[2] which appeared clean and free of contaminants. Based on the duration of the first flight, the pilot determined that the aircraft had sufficient fuel for the flight to Warraber Island and did not physically re-check the fuel or oil quantity prior to the second flight.

Before boarding the aircraft for the second flight, the pilot briefed the passengers on the aircraft's emergency equipment, including the use of seat belts, operation of the doors, and life jackets that were provided at each of the aircraft's seats. The life jacket demonstration was performed using a life jacket similar to those carried in the aircraft, and included the methods of securing the jacket and its inflation[3]. Two of the passengers were seated in the second row of seats; an adult in the right seat and a young child in the left seat, behind the pilot. The third passenger was seated in the third row, in the left seat beside the rear cabin door.

The takeoff from Horn Island and climb was described as normal by the pilot. The planned cruise altitude was 1,500 ft, but, due to some cloud and turbulence at that altitude, the pilot revised the cruise altitude to 3,500 ft. Upon reaching the revised cruise altitude, at about 10 NM from Horn Island, the pilot set cruise power, which included an engine speed of 2,350 revolutions per minute (RPM). The pilot reported that the aircraft was operating smoothly and that there was little to no turbulence.

When the aircraft was about 25 NM from Warraber Island, the pilot reduced power to start the descent and decreased the engine RPM to 2,300 RPM. Shortly afterwards, the pilot noticed a roughness in the engine and adjusted the mixture control in an attempt to restore smooth engine running, but without success. The pilot then noticed that the RPM had increased to 3,000, which was above the governed maximum of 2,700 RPM[4] and that the aircraft was descending at about 100 feet per minute (fpm).

The pilot contacted the operator's chief pilot on the discrete company radio frequency to advise him of the problem and to obtain some guidance, as there was no reference to this type of problem in the emergency procedures checklist. The pilot changed fuel tanks, switched on the boost pump, then attempted to reduce the RPM by reducing the engine power, but found that he could only achieve about 2,900 RPM. As this resulted in a rate of descent of about 300 fpm, the pilot attempted to reapply full power, but noticed that the engine was no longer able to produce full power and the aircraft was still descending. The pilot quickly assessed the situation, including the time and distance required to make a 180 degree turn back to Horn Island, and decided to continue to Warraber Island. The exact location of the aircraft at the time the pilot made this decision could not be determined.

The pilot reported that within 1 to 2 minutes of noticing that the engine RPM had increased to 3,000 RPM, the engine had stopped delivering any power and the

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2 The Type Certificate Data Sheet for the PA-32-260 (A3SO, Revision 31) lists the oil capacity as 12 US quarts, 9 ¼ US quarts of which is usable.

3 The aircraft was equipped with 'helicopter style' life jackets. These jackets were contained in a pouch attached to a waist belt. The chief pilot reported that it was standard company practice for all the occupants of their single-engined aircraft to have the life jacket secured around their waist at all times.

4 The Type Certificate Data Sheet for the PA-32-260 (A3SO, Revision 31) lists the engine limit as 2,700 RPM for all operations.

propeller began slowly windmilling in a shuddering manner. It was described as a smooth reduction in power, rather than an immediate power cut. The pilot twice attempted to restart the engine using the electric starter motor without success. The gauges reportedly indicated that there was sufficient fuel quantity and pressure, and that the engine oil pressure was in the normal range throughout the event.

At about 2,500 ft, the pilot informed the chief pilot that he was unable to maintain height and would not make Warraber Island. He instructed the passengers to make sure their seat belts were securely fastened and that they should put their lifejackets on, but not to inflate them. He then donned his own life jacket and prepared the aircraft for ditching. At about 1,500 ft, the pilot informed the chief pilot that they were 'going down'. Following that transmission, radio contact was lost and the chief pilot contacted emergency services to initiate a search and rescue response.

Ditching and survival

When the aircraft impacted the water, it pitched steeply nose-down, then settled back into a near-level attitude. During impact, the two passengers seated in the second row were flung forward. The young passenger seated behind the pilot had been forced against the back of the pilot's seat and the passenger in the right seat had been forced forward over the folding back of the front right seat into the instrument panel and against the right controls, gashing his forehead. The adult second row passenger later reported that he had unfastened his seat belt and that of the child beside him, prior to ditching, in the belief that it would aid their ability to quickly exit and avoid becoming trapped in the sinking aircraft.

The pilot and second row passengers exited the aircraft through the forward, right cabin door. The passenger in the third row exited through the rear, left cabin door. In the few minutes before the aircraft sank, the pilot assisted the second row passengers to unpack their life jackets from the plastic containers and to properly fit and inflate them. The third row passenger was not wearing their lifejacket correctly and had difficulty staying afloat.

After the aircraft sank, the pilot assembled the passengers together as a group and floated towards a nearby islet, guided by a lighthouse that was visible to them. After a short time they were located by an aircraft that was in the area and its pilot directed rescue helicopters to them. Two life rafts were dropped from the helicopters, but due to a lack of knowledge in their operation, the survivors were not able to inflate them. One of the life raft packages was used by the passenger with the poorly fitted life jacket for added buoyancy. After nearly an hour in the water, a rescue helicopter winched the survivors to safety.

A crew member of one of the search and rescue aircraft described the weather conditions as 'perfect, light south-east breeze of 8 kts, light ripple and very little swell'.

The crew of the search and rescue aircraft did not receive an emergency locator transmitter (ELT) signal. After the event, the pilot recalled that he had not activated the aircraft's ELT.

Pilot experience and training

The pilot held a commercial pilot (aeroplane) licence, endorsed with the special design feature of manual propeller pitch control, required for operating aircraft with constant-speed propellers. He held a valid Class 1 medical with no restrictions. The

pilot's total flying experience was 936 hours that included 17 hours on the aircraft type.

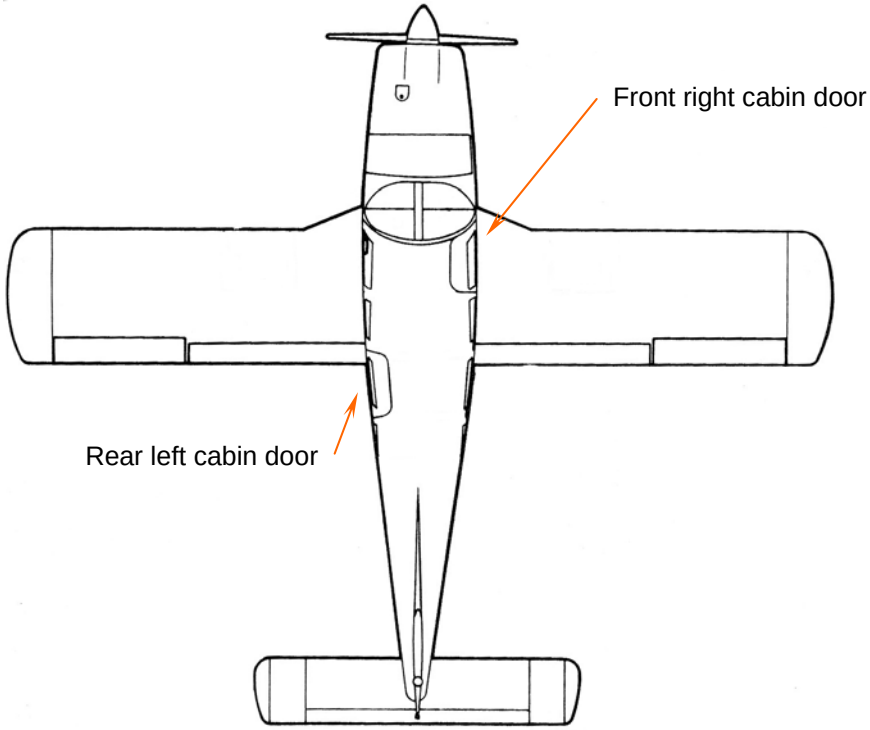
The pilot commenced employment with the operator in April 2007, and completed the operator's induction training, that included check flights on routes frequently flown by the operator and the aircraft types. Because most of the flights were over water, the operator included special training on ditching in the event of an engine failure. Both the pilot and the company chief pilot reported that the training included a briefing and discussion by the chief pilot on ditching procedures for each aircraft; its configuration, speed, and choice of landing direction in swells. As part of the operator's emergency training, the pilot received practical instruction on the use of life jackets and survival in the water, known as 'wet' training drill. The scope of that training did not include the operation of life rafts.

Aircraft information

The aircraft sank in approximately 17 metres of water and was not recovered. Consequently, no examination of the aircraft and its systems was possible.

The Piper PA-32-260 is a single-engine, low-wing, 6-seat, fixed-landing gear aircraft. The aircraft had two cabin doors; a front door over the right wing, providing access to the first two rows of seats (including pilots); and a rear door behind the aircraft's, left wing, providing access to the third (rear) row of seats (Figure 2).

Figure 2: Piper PA-32-260 top view



The aircraft was powered by a Lycoming O-540-E4B5 6-cylinder piston engine normally driving a Hartzell 2-blade constant speed propeller. On 30 January 2007,

the original 2-blade propeller fitted to PYD was replaced with a McCauley 3-blade constant speed propeller under a US Federal Aviation Administration Supplemental Type Certificate.

PYD was maintained as an instrument flight rules aircraft in accordance with a Civil Aviation Safety Authority (CASA) accepted system. This system consisted of CASA Civil Aviation Regulations 1988 42B Schedule 5 system of maintenance for the airframe, instruments, electrical and avionics systems, the PA-32 Series Maintenance Manual for the engines and applicable CASA airworthiness directives. Periodic inspections were required to be carried out at either 100 hours of operation, or 12 months, whichever occurred first. The logbooks for PYD indicated that the last periodic inspection had been carried out on 30 January 2007, when the airframe hours were recorded as 7,727.2 hours and the engine had 694 hours since overhaul (TSO).

The engine logbook noted that during this routine inspection, the engine was checked in accordance with CASA airworthiness directive AD/ENG/4, amendment 10. The maximum propeller RPM recorded during that inspection was 2,675.

The engine logbook also showed that since the engine had been overhauled and fitted to PYD, the engine oil pressure was adjusted down on two consecutive occasions, at 299 and 398 hours TSO, respectively. There was no indication in the logbook as to the origin or reason for the high oil pressure.

Metal was found in the oil filter on one occasion (at 199 hours TSO), but was noted as being ‘within Lycoming S.B. limits’. On all other checks, including the last periodic inspection carried out, the oil filter entry was either ‘clean’ or ‘no metal contamination’.

The only rectification work noted in the engine logbook was the replacement of an engine mount and the exhaust system was repaired. Airworthiness directive AD/PA32/81, which requires inspection of the oil hoses supplying the remote oil cooler, was also noted as having been completed during that maintenance.

The last non-scheduled aircraft maintenance had occurred on 10 March 2007 to replace a seal on the right landing gear.

The precise number of flying hours accumulated on PYD could not be determined with any certainty due to the current maintenance release being lost with the aircraft. However, the operator indicated that, on 27 May 2007, the aircraft had approximately 11.6 hours remaining until the next scheduled maintenance. The chief pilot flew the aircraft on the day before the accident and recalled that there were no outstanding defects on the maintenance release and that oil consumption figures appeared ‘normal’.

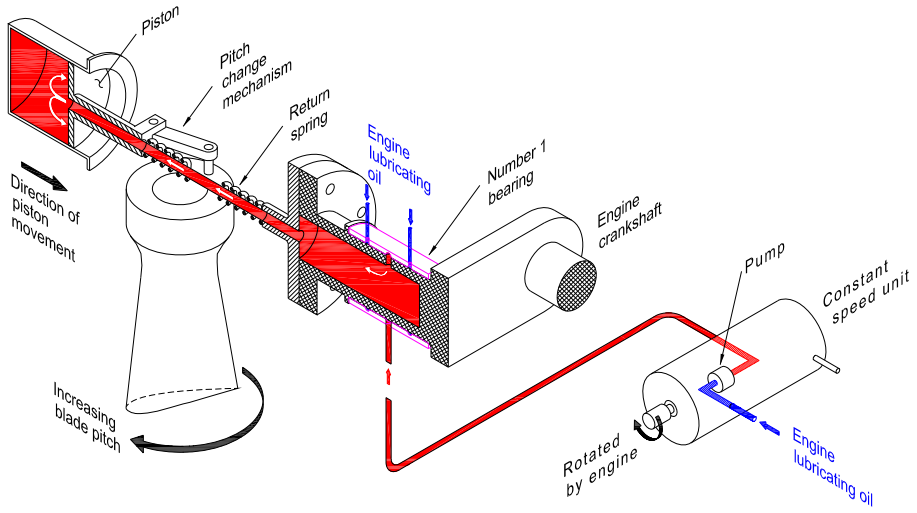
Constant speed propeller

The propeller RPM, and hence engine RPM, are controlled and maintained by adjusting the pitch of the propeller blades. Oil is taken from the engine lubrication system into the propeller constant speed unit (CSU). The CSU contains a high pressure oil pump and a governor. The governor controls the flow of pressurised oil to and from the propeller hub that contains a piston connected to a propeller blade pitch change mechanism. The CSU is mounted on the engine case near the Number-1 (most

forward) engine bearing. Oil flows to and from the propeller through an orifice in the crankshaft located at the Number-1 bearing.

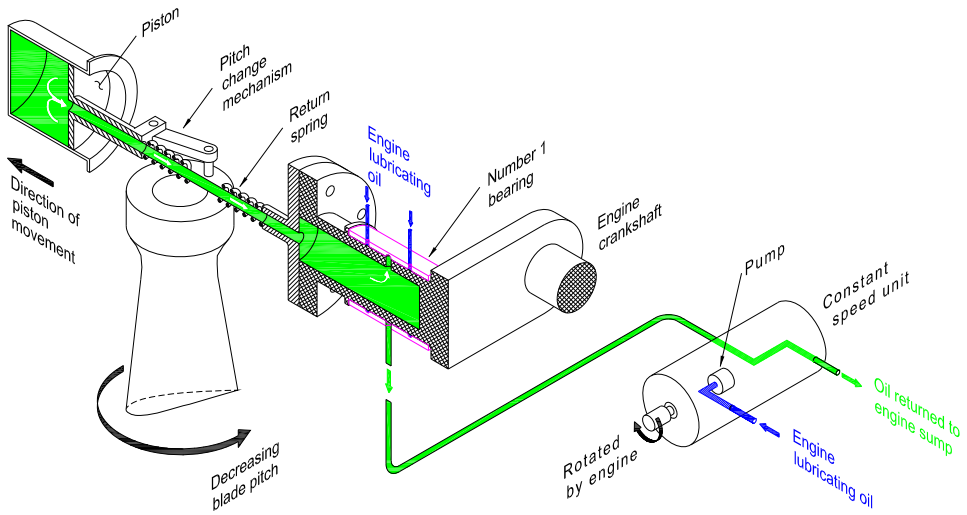
When the governor senses that the engine, and hence propeller RPM is too fast, it directs pressurised oil to flow into the propeller hub, which forces the piston against the internal spring, increasing the pitch of the propeller blades (Figure 3). This increase in pitch results in a higher load on the propeller, which then reduces engine RPM.

Figure 3: Constant speed propeller - engine RPM too high



Conversely, when the governor senses that the engine RPM is too low, it allows oil to flow out of the propeller. The spring forces the piston back, which reduces the pitch on the propeller blades and allows the engine to increase RPM (Figure 4).

Figure 4: Constant speed propeller - engine speed too low



A mechanism in the CSU controls the desired governing speed, allowing the pilot to set the desired engine RPM from the cockpit. During maintenance, the maximum allowable engine RPM is set by adjusting the high speed stop on that control mechanism. To allow for variation in factors, the propeller will normally be capable of moving to a pitch that is less than the maximum governed speed setting when pressure is released from the oil system. This normally only occurs when the engine is shut down.

Regulatory requirements and information regarding emergency equipment

The requirements for the carriage of emergency equipment and passenger briefing relating to overwater operations is contained in CASA Civil Aviation Orders Section 20.11 'Emergency and life saving equipment and passenger control in emergencies'. The operating and training procedures contained within the operator's operations manual generally complied with these requirements. However, neither the procedures for emergency evacuation nor ditching were specified in the aircraft's operations manual as required by CAO 20.11, subsection 10 - emergency procedures.

Of particular note in CAO 20.11 were the requirements for carriage and wearing of life jackets. CAO 20.11 subsection 5.1 required:

> 5.1.1 Aircraft shall be equipped with 1 life jacket for each occupant when the aircraft is over water and at a distance from land:
>
> (a) in the case of a single engine aircraft – greater than that which would allow the aircraft to reach land with the engine inoperative; and
>
> 5.1.7 Where life jackets are required to be carried in accordance with subparagraph 5.1.1(a) each occupant shall wear a life jacket during flight over water. However, occupants of aeroplanes need not wear life jackets during flight above 2000 feet above water.

This was reflected in the operator's operations manual for flights over water with the statement:

> 'Life jackets will be carried for each person in single engine aircraft and worn below 2000ft in accordance with CAO 20.11…'

There were sufficient life jackets carried on the flight.

Subsection 14 of CAO 20.11 requires that an operator of an aircraft shall ensure that all passengers are orally briefed before each takeoff on safety items, including the use and adjustment of seat belts, the location of emergency exits and where applicable the use of flotation devices. In addition to this, for aircraft engaged in charter operations, the briefing shall include a demonstration of the method of donning and inflating a life jacket.

The aircraft was not equipped with a life raft, nor was the carriage of a life raft required by CAO 20.11 for the flight. Accordingly, there was no requirement for the pilot to be trained in the use of life rafts.

In addition, CASA have produced guidance and educational material in the form of Civil Aviation Advisory Publication (CAAP) 253-1 (0)[5] and Flight Safety Australia magazine article 'Prepare to Ditch' in the January-February 2005 edition.[6] Both items provided information regarding ditching technique and survival considerations during and after a ditching.

5 Civil Aviation Advisory Publication 253-1(0) is available on the Civil Aviation Safety Authority website at: http://www.casa.gov.au/download/caaps/ops/253-1.pdf

6 Flight Safety Australia magazine is available on the Civil Aviation Safety Authority website at: http://www.casa.gov.au/fsa/2005/feb/index.htm.

ANALYSIS

Engine failure

Because the aircraft was lost at sea and not recovered, it was not possible to examine the engine and hence determine the reason for the engine failure. However, from the description provided by the pilot, it was apparent that the engine speed control system had become ineffective and could not maintain the RPM within the specified limits. The increase in engine revolutions per minute (RPM) above the maximum governed limit indicated that the propeller blades had been permitted to move to a pitch angle lower than that normally allowed by the constant-speed unit under those conditions. That indicated that insufficient oil pressure was supplied to the piston in the propeller.

Although continued operation of the engine above the maximum RPM limit would likely result in serious engine damage and ultimately failure, the short time interval between when the engine speed was reported to have increased and the loss of power occurred, suggests that there was also an oil supply disruption within the engine. As the propeller continued to rotate after engine power was lost, it is apparent that the engine did not completely seize due to lack of lubrication. However, the slow shuddering rotation of the propeller suggests that the engine rotation had become restricted due to part of the lubrication system becoming ineffective. It could not be determined which specific components within the engine lubrication and propeller control systems were affected by the disruption to the oil supply. However, given the commonality of the number-1 bearing to both systems, it was probable that it was one of the affected components.

Given that the oil quantity had been checked and found satisfactory earlier in the day, that there was no history of excessive oil usage, that the engine operation on the previous flight was normal, and the rapid onset of symptoms, there was probably nothing that the pilot could have done to prevent the increase in engine RPM and subsequent loss of power.

Ditching

The fact that the aircraft did not become inverted after contacting the water was largely due to the favourable sea conditions, but also indicated that the pilot had followed the operator’s recommended aeroplane configuration, speed and technique for ditching. The recent emergency procedures training provided by the chief pilot likely contributed to the pilot’s knowledge of procedures and skills that contributed to the successful ditching.

Although the inclusion of emergency evacuation and ditching procedures in the company operations manual would probably have had little effect on this particular occurrence, they would be a valuable resource for a pilot that has not recently undergone training in the procedures.

Use of safety equipment

The operator's procedures complied with regulatory requirements and the descriptions of the pre-flight briefing given by the pilot indicated that it was in accordance with the operator's procedures and the regulations. That briefing included an oral description and demonstration on the use of the life jackets.

The flight was originally planned to cruise at 1,500 ft. As Civil Aviation Order Section 20.11 required that life jackets be worn by each occupant when the aircraft was flown below 2,000 ft, all the occupants should have been wearing their life jackets from the commencement of the flight. However, it could not be confirmed if the passengers had worn them at any stage during the flight.

The pilot reported that during the descent, he instructed the passengers to don their life jackets, but on entry to the water he found that none of the passengers were wearing their life jackets. It was not made clear to the investigation why the passengers had not donned their jackets. The recent practical 'wet training' instruction on the use of the life jackets most likely provided the pilot with the knowledge to assist the passengers with donning and inflating their jackets.

There was no requirement to carry a life raft for the type of operation being performed in this class of aircraft, neither was there a requirement for the pilot to receive training in life raft operation, but given that the pilot was unable to inflate the life rafts dropped from the rescue helicopters due to a lack of knowledge of their operation, it may be of future benefit for that knowledge to be provided during emergency training.

There also appeared to be some misunderstanding from the passengers as to the use of the seat belts during a ditching. There was no indication that the pilot's briefing or instructions during the descent would have led them to believe that unfastening their seat belts would assist in exiting the aircraft following the ditching. The other passenger in the third row had not unfastened his seat belt. By unfastening their seat belts, the two passengers had exposed themselves to a greater chance of receiving serious injury from the deceleration forces during the ditching. Clear instructions from a pilot and/or cabin crew during an emergency descent for a ditching that seat belts are to remain fastened until after the aircraft has stopped may assist in minimising injuries and ensuring the best chances of survival.

Decision point

The pilot made the decision to continue to Warraber Island rather than return to Horn Island, based on his estimate of the distance to make the turn and the distance already travelled. The investigation could not determine the exact point at which engine problems began, so could not determine whether it was a greater distance back to Horn Island, but it was reported to be at or about the midway point. Even if the pilot had turned the aircraft around at the first sign of an engine problem, the subsequent loss of engine power probably would have precluded it from reaching Horn Island. It may, however, have placed them in a location that was closer to rescue services. Determination of a return/divert decision point, taking into consideration the location of support and rescue services, prior to departure could reduce a pilot's workload in a similar situation, simplifying the decision-making and allowing more time to concentrate on piloting actions.

FINDINGS

Contributing safety factors

- An oil supply problem probably developed within the engine that resulted in an increase in engine RPM and subsequent loss of power.
- The aircraft could not maintain altitude.
- The aircraft was outside gliding distance to land and ditched into the waters of Torres Strait.

Other safety factors

- Some of the passengers had unfastened their seat belts prior to the impact with the water, exposing themselves to increased chances of a serious injury.
- None of the passengers properly donned their life jackets prior to the ditching.

Other key findings

- The recent training received by the pilot probably assisted in the execution of a successful ditching.
- The environmental conditions were conducive to a successful ditching and subsequent water survival.
- Based on the planned cruise altitude, the occupants of the aircraft should have been wearing life jackets prior to departure.
- Although the pilot was familiar with the use of the emergency equipment on the aircraft, neither he nor the passengers were familiar with the equipment supplied to them during the rescue and as a result were not able to operate the life raft.

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

On 2 September 2008, the aircraft operator informed the Australian Transport Safety Bureau that it had undertaken to amend the company operations manual to include: for all flights over water in single-engine aircraft, life jackets are to be worn around the waist for the duration of the flight.