Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report – 200606530

Interim Factual

Loss of control – 9 km SE Raglan, Qld
31 October 2006
VH-ZGZ
Piper Aircraft Corporation PA31-350, Chieftain

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Weather radar image provided courtesy Bureau of Meteorology.

Abstract

On 31 October 2006 at 1955 Eastern Standard Time, PA31-350 aircraft, registered VH-ZGZ, was on descent to Gladstone Airport, Qld when its radar track disappeared from the air situation display in the Brisbane Air Traffic Control Centre. Subsequently, the aircraft was found to have impacted terrain approximately 9 km south-east of Raglan, Qld. The pilot and two passengers were fatally injured. The aircraft was destroyed by impact forces and post-impact fire.

The investigation is continuing.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. 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.

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

History of the flight

On 31 October 2006, a Piper Aircraft Corporation PA31-350 Chieftain aircraft, registered VH-ZGZ, was being operated on a private category instrument flight rules (IFR) flight from Emerald to Gladstone, Qld. On board the aircraft were the pilot in command and two passengers. One of the passengers was a qualified pilot but was not endorsed on the aircraft type.

After departing Emerald at 1807 Eastern Standard Time[1], the pilot contacted air traffic control and reported climbing to 7,000 ft with an estimated time of arrival at Gladstone of 2015. At 1813, air traffic control advised the pilot that ZGZ was radar identified 15 NM east of Emerald. At 1815, the pilot reported passing 6,000 ft and requested clearance to climb to 9,000 ft. At 1817, air traffic control issued a clearance to the pilot for the aircraft to climb 9,000 ft, and to track direct to Gladstone.

At 1820, the pilot reported level at 9,000 ft and requested clearance to divert up 10 NM left and right of track 'due build ups'. Air traffic control approved that request. At 1830, the pilot requested clearance to divert up to 15 NM left and right of track and 10 seconds later changed the request to 15 NM left of track. Air traffic control approved that request. At 1835, the pilot reported clear of the weather and requested clearance to track direct to Gladstone and to descend to 7,000 ft. Air traffic control approved those requests.

At 1848, the pilot reported top of descent to Gladstone. Air traffic control cleared the pilot to descend. At 1853, the pilot reported changing frequency to the Gladstone common traffic advisory frequency (CTAF). Air traffic control advised the pilot that the aircraft was leaving 5,500 ft and that the radar and control services were terminated.

At 1856, air traffic control noticed that the aircraft's symbol was no longer evident on the air situation display screen and the controller attempted to contact the aircraft by radio. The controller also requested pilots of other aircraft operating in the Gladstone area to attempt to contact ZGZ on the CTAF frequency. All attempts were unsuccessful.

Shortly after 1900, the Gladstone Police were notified of an aircraft accident in the Raglan area. Subsequently, wreckage of the aircraft was located near Raglan, approximately 39 km west of Gladstone. The three occupants were fatally injured. The aircraft was destroyed by impact forces and post-impact fire.

Recorded radar information

The recorded air traffic control radar data included information on the aircraft's track, groundspeed and altitude. Figure 1 shows the recorded track of the aircraft

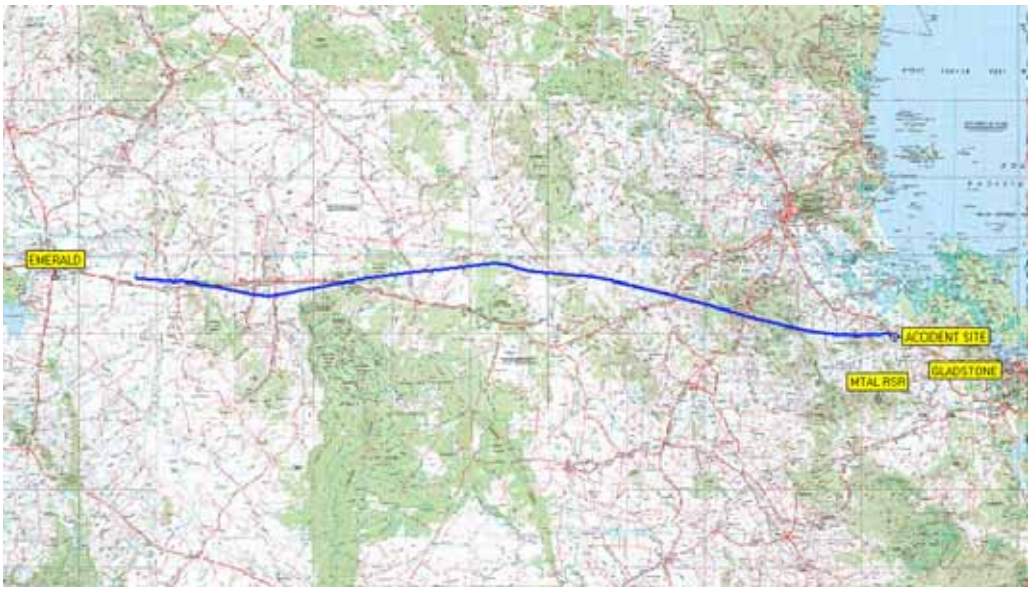
1 The 24-hour clock is used in this report to describe the local time of day, Eastern Standard Time (EST), as particular events occurred. Eastern Standard Time was Coordinated Universal Time (UTC) + 10 hours.

from its position when it initially entered radar coverage until radar contact was lost. The recorded altitude profile showed that the aircraft maintained a constant altitude during the cruise segments of the flight. The groundspeed profile showed speeds that were consistent with the aircraft's phase of flight. During the cruise at 9,000 ft, the aircraft maintained a groundspeed in excess of 200 kts. During the cruise phase at 7,000 ft, the aircraft groundspeed exceeded 185 kts.

The final 4 minutes of radar data showed the aircraft in a steady descent at about 600 ft per minute, with a groundspeed of about 180 kts. The last valid data record showed an altitude of about 5,400 ft and a groundspeed of 177 kts. Throughout those 4 minutes, the recorded track remained steady on about 191 degrees magnetic.

The last recorded position of the aircraft was within 1 km of the accident site.

Figure 1: Recorded radar track of VH-ZGZ.



Note: The label 'MTAL RSR' denotes the location of the Mt Alma air traffic control radar antenna.

Events preceding the accident flight

The aircraft was imported to Australia from the Philippines in September 2006. The ferry pilot reported that the aircraft and its systems had functioned normally during the flight from the Philippines.

On 2 October 2006, the aircraft underwent an inspection for the issue of an Australian Certificate of Airworthiness (CoA) and a 100-hourly maintenance inspection by an organisation at Moree, NSW. No abnormalities were reportedly found during those inspections. No engine starting difficulties were experienced. The owner took possession of the aircraft at Archerfield, Qld, on 9 October 2006 and the pilot in command on the accident flight was endorsed on the aircraft on the same day. He flew the aircraft from Archerfield to Gladstone later that afternoon and flew as pilot in command of ZGZ on all subsequent flights. For all but a few of those flights, the other pilot on the accident flight occupied the right cockpit seat of ZGZ.

On 11 October, the aircraft was flown from Gladstone to Mareeba, Qld, where the pilot was unable to start the right engine. Licensed aircraft maintenance engineers (LAMEs) who examined the aircraft reported that the timing on both right engine magnetos required adjustment and that they replaced the right engine starter switch because of a short circuit. They reported that they advised the pilot in command and the other pilot that the right engine starting system required further work. However, the pilots decided to fly the aircraft back to Gladstone. During that flight, the aircraft made an unscheduled landing at Townsville, reportedly because one of the right engine top cowling locks was not secure[2].

The next reported activity concerning the aircraft was on 19 October at Gladstone when the left engine could not be started. Checks revealed that there was a short circuit in the left engine starter motor. A replacement starter motor and a new battery were fitted to the aircraft. The following day, the right engine could not be started and a LAME was flown from Bundaberg to examine the aircraft. He assessed that the starting vibrator was causing the problem, but managed to start the engine. ZGZ was then flown to Bundaberg to drop off the LAME. However, the right engine would not start for the return flight. The LAME reported that he then conducted tests which established that the starting vibrator points and magneto capacitors were unserviceable. He replaced those items but also found that spark plug gaps exceeded the correct settings, that the magneto timing was incorrect, and that one of the brushes in the right alternator was stuck. He rectified those faults and reported that both engines then started and operated normally. The aircraft subsequently returned to Gladstone.

The Bundaberg LAME recalled that he had checked the right engine timing and noticed that there were no timing marks on the front plate ring gear, but there were marks on the rear plate ring gear. From the marks on the rear plate and hand-swinging the propeller, he assessed that the starter support ring gear position was correct.

On 26 October, the Bundaberg LAME received a call that the right engine could not be started. He travelled to Gladstone to examine the aircraft but could find no faults and was able to start the engines. The intention was to fly the aircraft to Emerald, so the LAME travelled in the aircraft in case further problems were encountered. The LAME reported that during the flight, the right engine cylinder head temperature (CHT) increased to above 400 degrees F[3] and was much higher than the left engine CHT. The exhaust gas temperatures (EGTs) were the same for both engines and were within limits. The LAME reported that the pilot in command had noticed the high CHT and the LAME encouraged the pilot to operate the engine cowl flaps to control the CHT. Partial opening of the cowl flaps was sufficient to maintain the CHT below 400 degrees. During the flight, the pilot in command operated the aircraft on autopilot. The LAME recalled that the autopilot appeared to have been functioning normally.

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2 There was a requirement for that event to be reported to the ATSB as an air safety incident in accordance with the Transport Safety Investigation Act (2005). However, the ATSB did not receive any such report.

3 The Piper Aircraft Corporation published the PA31-350, Navajo Chieftain, Information Manual, Report: 2046. Section 2 of Report 2046 addressed Limitations. It stated that the maximum CHT was 500 degrees F.

The aircraft arrived at Emerald around midday on 26 October. Witnesses (including a LAME) at an aircraft maintenance facility at Emerald reported that, after refuelling, the left engine appeared to start normally but the right engine could not be started. They observed repeated attempts over a period of 45 minutes or more to start the right engine before the Bundaberg LAME asked them for a replacement starter motor. The Emerald LAME assisted the Bundaberg LAME to replace the starter, but the right engine still could not be started**.**

The LAMEs then undertook fault checking. They found the primary (P) lead[4] was chafed, creating a short circuit. That fault was repaired, but the engine still would not start. The spark plugs and leads were checked and found serviceable. They then found contamination in one of the magnetos and replaced that unit. The right engine then started but surged at low RPM. The fuel injectors were then removed and cleaned and two injectors were found partially blocked. Another injector, that was the incorrect type for the engine, was replaced with a correct one. The other fuel injectors were refitted to the engine. The engine then ran roughly at low RPM but operated satisfactorily at high RPM.

The pilot in command, accompanied by the Emerald LAME, took the aircraft for a test flight. The LAME observed high CHT (just below the red line maximum limit of 500 degrees F), low EGT, and high fuel flow during the takeoff and told the pilot to land as soon as possible. The LAME reported that he then replaced the fuel control unit, but upon restart the engine still surged at idle RPM.

The Emerald LAME then used a timing light to check the ignition timing set up. He noticed that the starter support timing marks appeared to be in the incorrect position. To investigate further, the propeller was removed and it was found that the identification marks on the starter support assembly did not line up with the identification marks on the crankshaft face. They were displaced by approximately 120 degrees (see Figure 2[5]). The LAME checked the starter support for damage, reassembled the components in the correct alignment, and refitted the propeller. The engine then ran normally during a ground run.

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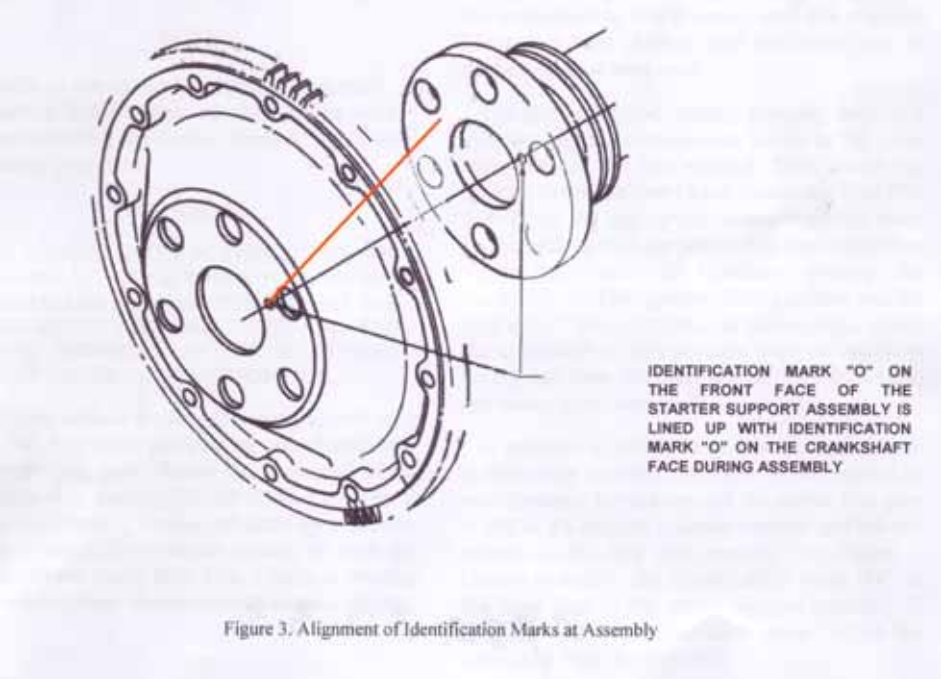
4 The P lead is a wire linking the starter switch to the primary (P) windings in the magneto. Its purpose is to earth or switch off the magneto.

5 Diagram taken from Avco Lycoming Textron Service Instruction No 1437, Engine Timing Marks, August 15 1986.

Figure 2: Showing starter support assembly and crankshaft face.



Note: The red line indicates the alignment found when the propeller was removed at Emerald.

The aircraft maintenance records indicated that, between the time the aircraft arrived in Australia and the removal of the right propeller at Emerald, there had been no other occasion involving removal of propeller/s from the aircraft. That information was confirmed during interviews with those who had performed maintenance on the aircraft.

The pilot and the Emerald LAME subsequently test flew the aircraft for about 20 minutes and checked engine operation at climb, cruise, and descent power settings. The LAME reported that all engine parameters were normal during that flight. At the completion of the flight, the engines were left running and the passengers boarded the aircraft for the flight to Gladstone. The passenger, who was a pilot, was seen to occupy the right cockpit seat before the aircraft taxied.

The Emerald LAME reported that the pilot selected the outboard tanks before landing from the test flight[6]. He did not observe the pilot change the tank selection after landing.

The wreckage

Examination of the accident site revealed that the aircraft had impacted open ground on the side of a hill at high speed in a very steep nose-down attitude (Figure 3). The relative angle between the terrain slope and the flight path was greater than 70 degrees.

6 Navajo Chieftain, Information Manual, Report 2046, in Section 4, Normal Procedures, stated that the fuel selectors were to be placed in the INBOARD tank positions for takeoff and landing.

Figure 3. Aerial view of accident site.

The force of the impact and the subsequent fire had caused the disintegration of much of the aircraft structure.

Examination of the wreckage confirmed that all the aircraft extremities were at the impact site. That information enabled in-flight break-up to be discounted as part of the accident sequence.

Both propeller/engine combinations were embedded in hard, dry, rocky earth at the accident site. Excavation of the propellers revealed marked differences in the impact signature of each propeller. (Figures 4 and 5).

Figure 4: After excavation of the left engine/propeller.

Figure 5: After excavation of the right engine/propeller.

The engines and propeller structures, some remnants of the electrical and fuel systems and some flight instruments, were removed from the accident site for further examination.

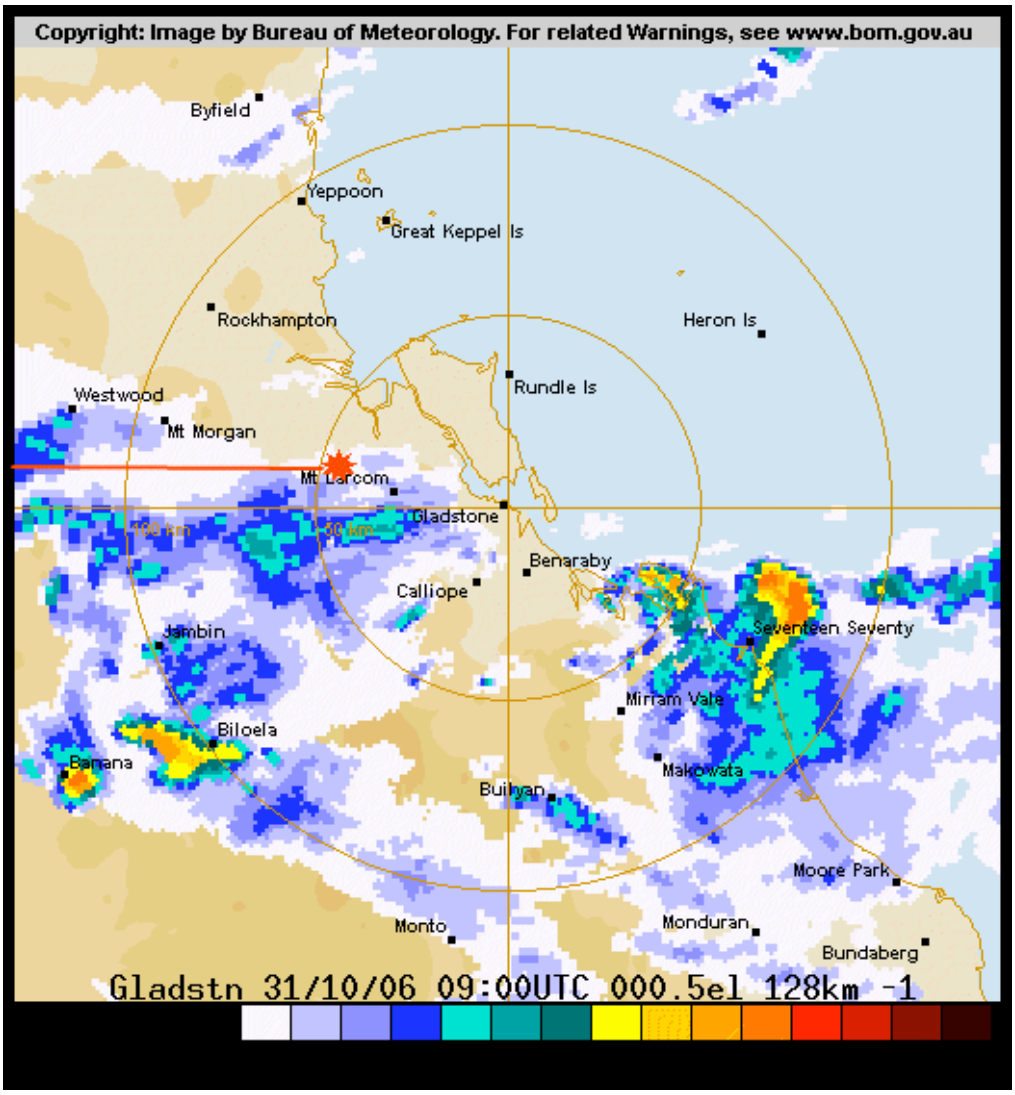
The weather

On 31 October 2006, a high pressure ridge extended along the Queensland coast and an inland trough extended north-south through central Queensland. During the afternoon, showers and thunderstorms developed east of the trough and moved

towards the coast. The Area 40 amended forecast, issued at 1649, was for scattered showers and isolated thunderstorms northwest of a line Maryborough to Goondoowindi. The forecast wind at 7,000 ft was variable at 10 kts, and 270 degrees at 10 knots at 9,000 ft.

The Bureau of Meteorology's Gladstone Weather Watch Radar image recorded at 1900 is shown at Figure 6[7]. The approximate track of the aircraft and the accident location (in red) has been superimposed on that image.

Figure 6: Bureau of Meteorology Gladstone weather radar image, 256 km radius, recorded on 31 October 2006 at 1900 EST.



Witnesses in the area reported conditions as overcast with light rain and very dark at the time of the accident.

No lightning activity was recorded within a 20 km radius of the accident location between 1700 and 2000.

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7 The Bureau of Meteorology advised that topography restricted the ability of the Gladstone radar so that it detected only major echoes to the northwest and the south-southwest.

The aircraft

The aircraft was manufactured in the US in 1977 and was imported into the Philippines in 1997. It was stored in a hangar while in the Philippines and had been operated for about 139 hours between September 2003 and September 2006, including the ferry flight from the Philippines to Australia. At the time of the accident, the aircraft had a total time in service of approximately 3,977 aircraft hours.

The aircraft was fitted with two Lycoming T10-540-J2B engines. The left engine had accumulated 6,934.6 hours and the right engine 8,055.8 hours at the time of the accident. Both engines had been overhauled in January 2004 and had since operated for 142.2 hours. Both propellers had been overhauled in August 2004, and had since operated for 110.45 hours.

The aircraft was fitted with a Bendix 160 Weather radar and a Garmin GPS 155 system. A King KFC200 flight control system, incorporating an autopilot and a flight director was fitted to the aircraft.

The pilot in command

The pilot in command held a commercial pilot's licence and in December 2004[8] had in excess of 3,900 hours flying experience, including 545 hours on multi-engine aircraft. He held a command multi-engine instrument rating and a Grade 1 multi-engine instructor rating.

At December 2004, the pilot in command's multi engine experience included flight time on Piper PA 23 and 34, Beech 76 and Partenavia PN68 aircraft.

The pilot in command completed Piper Chieftain endorsement training (in VH-ZGZ) on 9 October 2006. He had flown approximately 12 hours in ZGZ at the time of the accident.

The other pilot on board the aircraft

The other pilot on board the aircraft was a member of the family company that owned the aircraft. He held a private pilot's licence and had about 505 hours flying experience, including 8.4 hours night flying. He had completed twin-engine endorsement training in February 2006. According to his pilot's log book, he had accumulated 57.6 hours on PN68 aircraft, of which 20.4 hours were as pilot in command. He had flown 4.3 hours in PA34 aircraft, all of which was recorded as dual flight time. None of his flight time on PN68 or PA34 aircraft was logged as night flight. He had logged 4.1 hours instrument flight time, all in single engine aeroplanes. He did not hold an instrument flight rating.

The other pilot had flown with the pilot in command many times previously. He had accompanied the pilot in command on almost all flights in ZGZ after the company took delivery of the aircraft on 9 October 2006. His pilot's log book recorded dual flight time in ZGZ with the pilot in command on 9, 11, and 13 October. Those records totalled 9.7 hours, including 2 hours night flight. Other than the flight time being recorded under 'dual' in his log book, there was no other documentary

8 The pilot in command's flight records after December 2004 have not been located.

evidence that the flights were for endorsement training. The last entry in the passenger's log book was for 25 October. Between 9 and 31 October, the passenger was reported to have said to others that he was in the process of gaining an endorsement on ZGZ.

Examination of items removed from accident site

At the time of publication of this report, examination of items removed from the accident site remained ongoing. Preliminary results included the following:

- The pilot's attitude indicator was a gyroscopic instrument. The gyroscope was air driven. The remains of the instrument contained fragments of the gyro case and the gyro rotor. Examination of those parts showed signs of rotational scoring on both the inside of the gyro case and on the gyro rotor.
- Impact forces destroyed the integrity of the left engine structure. The engine had also sustained substantial fire damage (Figure 7). The crankshaft was bent and compressed axially along its forward length.

Figure 7: The left engine.

- Impact forces destroyed the integrity of the right engine structure to a greater extent than sustained by the left engine. The engine was substantially fire damaged. The crankshaft of the right engine had fractured adjacent to the first (forward-most) connecting-rod throw (Figure 8). The forward section of the crankshaft remained connected to the propeller flange. The nature of the crankshaft failure was consistent with the forces sustained during the impact of the aircraft and the engine with the terrain. There was no evidence that any latent defects, such as fatigue cracking or material flaws, were present with the crankshaft or associated forward big-end connection; nor was there any evidence of any defects or deficiencies within the crankshaft that had

contributed to the failure. Checks against the engine manufacturer's service bulletins confirmed that the right engine crankshaft was not included in the range of components identified by the manufacturer for mandatory replacement.

Figure 8: The right engine and fractured crankshaft (arrowed).

Ongoing investigation activities

Ongoing investigation activities will include further examination and consideration of the following:

- recorded radar and voice transmission data
- the experience, training and qualifications of the pilots on board the aircraft
- the maintenance history of the aircraft, including the engines
- the operating status of the engines at impact
- the operating status of the propellers at impact
- the remnants of cockpit instruments that were recovered
- the aircraft's autopilot and flight control systems
- the aircraft's fuel status
- the en route weather.