



Collision with terrain, VH-WXC, Cessna 210M

257 km SW Warburton, WA

17 October 2007

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Abstract

On 17 October 2007, the pilot of a Cessna Aircraft Company C210M, registered VH-WXC, was fatally injured when his aircraft impacted terrain about 257 km south-west of Warburton, WA.

The pilot had delivered an item of general freight at Warburton and was returning to Kalgoorlie when the accident occurred. The aircraft was being operated at night under the visual flight rules.

The investigation is continuing.

FACTUAL INFORMATION

The information contained in this interim report is derived from the investigation of the occurrence and is ongoing. Readers are cautioned that there exists the possibility that new evidence may become available, that alters the circumstances depicted in the report.

History of the flight

At about 1440 Western Standard Time¹ on 17 October 2007, the pilot of a Cessna Aircraft Company C210M, registered VH-WXC, departed Kalgoorlie, WA to deliver an item of general freight to Warburton and then return to Kalgoorlie. That flight was arranged at short notice and the pilot was called in to work to undertake the flight.

At 1716 the pilot called Flightwatch² on high frequency (HF) radio and cancelled his SARTIME³ for arrival at Warburton. After landing, the pilot offloaded the freight and each of the aircraft's fuel tanks was refuelled to 'tabs'⁴. That provided 249 L of useable fuel on board the aircraft for the return flight, which was to be carried out under the visual flight rules (VFR). The pilot was the sole occupant of the aircraft.

A series of HF radio transmissions that were recorded on the Flightwatch frequency between 1750 and 1752 were identified as originating from the pilot of the aircraft. Although two-way communication was not established between the pilot and Flightwatch, a review of those transmissions suggested that the pilot was attempting to nominate a SARTIME for his arrival at Kalgoorlie. That was the last transmission recorded from the pilot.

The pilot's house mate contacted the aircraft operator when the pilot failed to arrive home as expected that evening. A check of the airport by the operator confirmed that the aircraft was overdue, AusSAR⁵ was notified and a search was commenced. A search aircraft subsequently

1 The 24-hour clock is used in this report to describe the local time of day, Western Standard Time (WST), as particular events occurred. Western Standard Time was Coordinated Universal Time (UTC) +8 hours.

2 Flightwatch is the generic radio call-sign of the on-request flight information service, and responds to pilot requests for operational information.

3 The time nominated by the pilot for initiation of Search and Rescue action if a report was not received by Flightwatch.

4 Metallic tabs inside each tanks' filler neck provided a visual indication of a reduced fuel tank capacity.

5 AusSAR is the Australian agency responsible for coordinating search and rescue activities.

located the aircraft wreckage, approximately 257 km (139 NM) along the track from Warburton to Kalgoorlie.⁶

The investigation estimated that the accident aircraft would have been in the vicinity of the accident site about 1 hour after departing Warburton.

The aircraft was seriously damaged⁷ by impact forces and the pilot was fatally injured.

Personnel information

The pilot was a New Zealand citizen. He held an Australian Commercial Pilot (Aeroplane) Licence, a Command Multi-Engine Instrument Rating and a Grade 3 Instructor Rating. The pilot had completed renewals of his instrument and instructor ratings during May 2007.

The pilot held a Class 1 Civil Aviation Medical Certificate with no restrictions.

Although the pilot was called in at short notice for the flight, he was reported to have been well rested prior to duty and in normal spirits before departing Kalgoorlie. The pilot was observed to eat lunch prior to departing for Warburton and to complete flight planning activities.

A review of the pilot's logbook showed that he had accrued 1,340.8 hours total aeronautical experience, of which 29.3 hours had been flown at night. The logbook indicated that the pilot had 102.1 hours flying the C210 type of aircraft, including 5.3 hours at night.

The operator's documentation recorded the satisfactory completion by the pilot of a Cessna 402 type check during August 2007 and a proficiency check in the accident aircraft in May 2007.

The pilot last flew on 16 October 2007 and had been free of duty from about 1800 that evening.

Aircraft information

The aircraft was manufactured in 1978 and was a six-seat, single piston-engine aircraft with

retractable landing gear. The aircraft was maintained by the operator in accordance with the aircraft manufacturer's system of maintenance.

A maintenance release for the aircraft was issued on 10 September 2007, following a scheduled maintenance inspection. That maintenance release was issued at 11,111.9 hours total time in service and indicated that the aircraft could be operated in the charter operational category, by day or night under the VFR.

The maintenance release was not able to be identified at the accident site, but was reported to be with the other documentation carried on board the aircraft when it departed Kalgoorlie. Records maintained by the operator indicated that, at the time of the accident, the aircraft had flown about 43 hours since the last scheduled maintenance.

The aircraft engine had accumulated about 1,625 hours since its last overhaul⁸ and the propeller about 1,325 hours since new.⁹

Flight instrumentation

The aircraft was equipped with conventional flight instruments.

The aircraft's attitude and heading were displayed to the pilot via a gyroscopically-powered:

- attitude indicator, which provided the pilot with information about the pitch and roll attitude of the aircraft
- directional indicator, which provided information about the aircraft's heading
- turn coordinator, which provided information about the direction, rate and coordination¹⁰ of any turns.

An engine-driven, rotating vane-type vacuum pump provided suction to operate the gyroscopes that were contained in the aircraft's attitude and directional indicator flight instruments. The single-source vacuum system was equipped with a

6 That track was 220 degrees magnetic from Warburton.

7 The Transport Safety Investigation Regulations 2003 define 'serious damage' as damage that results in the 'destruction of the transport vehicle'.

8 The engine manufacturer specified 2,000 hours engine operation between overhaul.

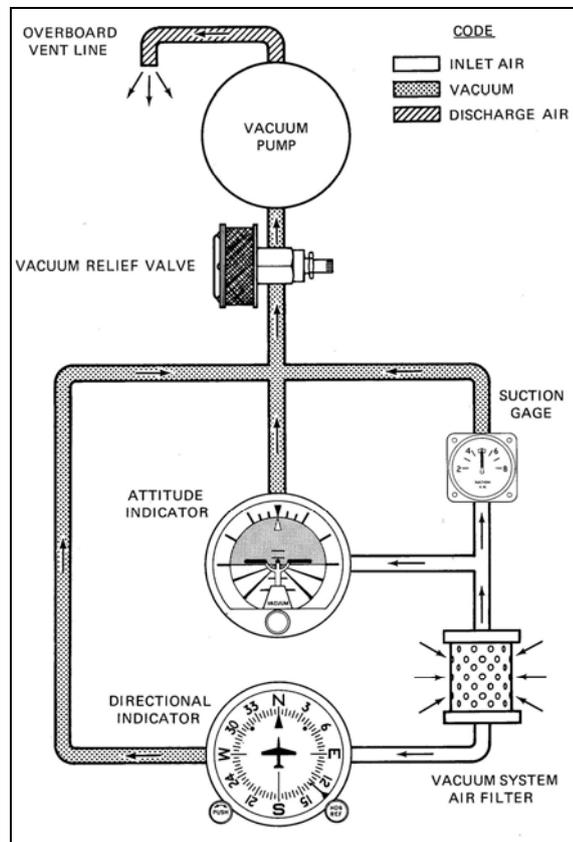
9 The propeller manufacturer specified 1,500 hours operation between overhaul.

10 A measure of control about three axes to avoid slip or skid.

vacuum relief valve that regulated the suction provided to those instruments (Figure 1).

The aircraft manufacturer's Aircraft Flight Manual (AFM) indicated that a suction of 4.6 to 5.4 ins of mercury (in Hg) was required to operate the suction-powered gyroscopic flight instruments. The AFM indicated that a suction reading outside of that range may indicate a system malfunction or improper adjustment and that, in such case, the attitude and directional indicators should not be considered reliable.

Figure 1: Schematic of aircraft instrument vacuum system



A suction gauge was mounted on the right of the cockpit instrument panel and could be used by the pilot to monitor the operation of the engine-driven vacuum pump. In addition, the gauge provided an indication of the suction being supplied to the gyroscopes in each of the attitude and directional indicators.

The aircraft was not equipped with a secondary vacuum pump or a standby source of suction. There was no warning light in the C210M to indicate to the pilot that the suction was outside the range required for correct instrument operation.

The aircraft's maintenance documentation recorded the replacement of the engine-driven vacuum pump on 2 August 2007, which was approximately 73 hours prior to the accident. The maintenance documentation recorded no other work on the aircraft's vacuum system since that time.

The turn coordinator used an electrically-powered gyroscope to provide the pilot with information about the aircraft's direction and rate of turn.

Additional equipment

The aircraft was equipped with an electrically-powered, two-axis (aileron and elevator control) autopilot, designed to provide automatic pitch and roll stability as commanded by the selected mode of operation. Pilots who had recently flown the aircraft reported that the autopilot was not serviceable.

The aircraft operator published a Minimum Equipment List (MEL) that stipulated the minimum equipment required to operate the aircraft. That document indicated that a serviceable autopilot was not required for VFR charter or IFR freight operations.¹¹

The aircraft was equipped with a global positioning system (GPS) that was suitable for VFR use, two very high frequency (VHF) omnidirectional radio range (VOR) radio receivers and an automatic direction finding (ADF) receiver.

Fuel

The stipulated fuel for the aircraft was 100LL/100 minimum grade aviation gasoline (AVGAS). Two fuel tanks provided a total fuel capacity of 336 L useable fuel. An examination of the refuelling documentation showed that the aircraft departed Kalgoorlie fully fuelled. In addition, that documentation indicated that 79 L of AVGAS was added to the aircraft at Warburton.

The investigation estimated that about 166 L was consumed during the outbound flight from Warburton at a consumption rate of about 60 L/hour. Based on the reported total fuel on board the aircraft after refuelling at Warburton, it was

¹¹ An autopilot was not stipulated by the relevant regulations as equipment required for flight at night under the VFR.

estimated that, at the time of the accident, there was about 190 L of fuel on board.

The maximum take-off weight for the aircraft was 1,723 kg. At the time of the accident, the operating weight of the aircraft was estimated to be about 1,260 kg and the centre of gravity within the manufacturer's specified limits.

Meteorological information

Last light¹² at Warburton was 1805 on the evening of the accident and 1814 in the vicinity of the accident site. At the time of the accident, there was a crescent moon, with 29% of its visible disk illuminated. The elevation of the moon was about 60 degrees above the western horizon.

The Bureau of Meteorology (BoM) conducted a post-accident analysis of the weather conditions during the afternoon and evening of the accident. That analysis indicated that a cold front and middle-level trough were moving through the south-western parts of WA during the afternoon and were approaching the Western Goldfields. Ahead of the front, a well-developed surface trough extended from the southern Pilbara to the Eucla regions. That surface trough was estimated to have intersected the aircraft's planned track about mid way along the Warburton to Kalgoorlie track.

The BoM analysis indicated that, although not directly observed in the region, it was likely a band of thunderstorms was associated with, and orientated along the surface trough, and that their development would be aided by weak instability in the mid-levels of the atmosphere. In addition, the BoM advised that, due to the relatively low surface humidity, the thunderstorms were likely to have had a relatively high base (around 11,000 ft above mean sea level (AMSL)), and were unlikely to have produced heavy rainfall or to have reduced the horizontal visibility below 5,000 m in the vicinity of the base of the thunderstorms. However, the BoM indicated that the dry air beneath the thunderstorms was likely to have evaporated any rain, and could have contributed to the development of strong downbursts in the

vicinity of any thunderstorms, resulting in strong wind gusts or squalls with blowing dust.

The BoM forecasts for Areas¹³ 61 and 64 and valid for the return flight to Kalgoorlie were consistent with the BoM post-accident analysis. Those forecasts included generally north-westerly winds at 25-30 kts, isolated thunderstorms and showers, with visibility reducing to 8,000 m in any showers and 5,000 m in thunderstorms. Cumulonimbus cloud between 10,000 and 35,000 ft was forecast associated with the thunderstorms and scattered altocumulus and altostratus cloud above 12,000 ft. Moderate turbulence was predicted until 1700 due to thermal activity

Proprietary equipment that recorded lightning activity within the region indicated lightning activity along a band running generally north-west to south-east and intersecting the pilot's track about halfway between Warburton and Kalgoorlie. That data was consistent with the estimated position of the surface trough. Significantly, that data did not record any lightning activity within 185 km (100 NM) of the aircraft, during the period of time that the aircraft was estimated to have been approaching the vicinity of the accident site.

Communications

At Kalgoorlie, pilots' radio transmissions were recorded in order to monitor aircraft movements at the aerodrome. An examination of those recordings confirmed the normal operation of the aircraft's VHF radio on departure.

The Warburton Common Traffic Advisory Frequency (CTAF) was not recorded.

A review of the recordings of the relevant Air Traffic Services (ATS) VHF frequencies along the route revealed no transmissions by the pilot, including on 130.9 MHz, which was available from on the ground at Warburton.

Wreckage and impact information

The aircraft impacted the sandy, desert-type terrain (Figure 2) at high speed and was seriously

12 Last light is consistent with the end of evening civil twilight, when the centre of the sun is at an angle of 6 degrees below an ideal horizon.

13 For the purposes of providing aviation weather forecasts to pilots, Australia is sub-divided into a number of forecast areas. The occurrence flight was contained in Areas 61 and 64.

damaged⁷ by impact forces. The fuel tanks ruptured on impact and there was a post impact fire.

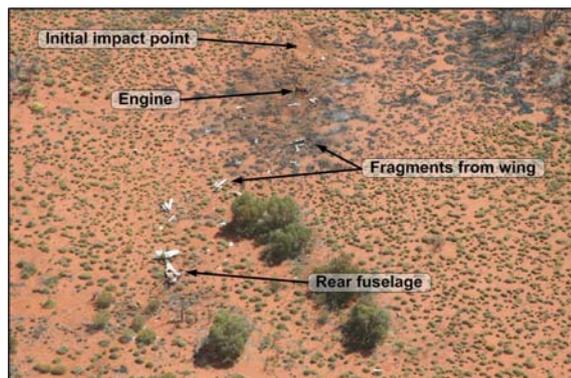
The elevation of the terrain in the vicinity of the accident site was about 1,450 ft. The ground track of the aircraft immediately prior to impact was approximately 217 degrees magnetic and the rear fuselage came to rest in the direction of flight, approximately 50 m beyond the initial impact point.

The aircraft's engine and propeller were located a short distance from the initial impact point and one of the propeller blades had fractured as a result of overstress during the impact sequence. Damage to the propeller blades and damage to the propeller hub mounting flange was consistent with the propeller being under engine power at the time of collision with terrain.

Although badly disrupted, the instrument panel remained mostly attached to the engine firewall and some instruments were recovered for laboratory examination.

The aircraft's fuel caps were found secured and there was no evidence of an in-flight leakage of fuel. At impact, the wing flaps were in the 'UP' position and the landing gear was retracted.

Figure 2: Photograph overhead the accident site



Fragments of coloured lens from each of the aircraft's navigation lights¹⁴ and of the anti-collision beacon were found in the immediate vicinity of the initial impact point. The location of those fragments relative to the impact point indicated that the aircraft was in an inverted

attitude when it collided with terrain. The orientation of ground marks made by the leading edge of the wing and the vertical stabiliser was consistent with the aircraft being inverted in a 30 degrees left-wing low, 20 degrees nose-down attitude at impact.

All major aircraft components were located at the accident site and the aircraft was assessed as being intact prior to its collision with terrain.

Due to the break-up of the aircraft, the disruption to the aircraft fuel tanks and fuel lines, and the post-impact fire, it was not possible to obtain a fuel sample from the wreckage.

The drive pin between the crankcase accessory drive and the engine-driven vacuum pump was found intact. That suggested that the vacuum pump was physically connected to the engine's accessory drive at the time of the accident.

The suction gauge was recovered from the remnants of the cockpit instrument panel. Examination of that gauge showed witness marks on the metal face of the instrument that were made by the indicating needle when it contacted that surface. Those marks were consistent with an indication of about 3.0 ins Hg of vacuum at that time.

The engine tachometer was recovered from the instrument panel. Examination of that gauge revealed witness marks that were made by the tachometer indicating needle, and were consistent with an indication of almost 2,300 engine RPM at the time the needle contacted the face of the instrument.

Witness marks on the faces of the cylinder head temperature gauge and oil temperature gauge were consistent with the indication of normal engine operation at the time the needles contacted their respective instrument faces.

The carbon impeller vanes from the engine-driven vacuum pump were found to have shattered and components from the vacuum pump were recovered for further examination. That examination found no defect with the pump assembly, and concluded that the damage to the impeller vanes was consistent with a high energy impact and sudden stoppage of the components while under rotation.

14 Wingtip (red on the left and blue-green on the right) and tail (white) lights that enhance an aircraft's visibility at night.

The attitude and directional indicators were recovered from the accident site. Although the cases of each instrument were disrupted, each instruments' brass gyroscope rotor remained within its respective case assembly. Further examination of the gyroscope rotors revealed damage that was consistent with each being in a low rotational energy state at the time of impact with terrain. That was characterised by minimal scuffing and rubbing of the rotor against its rotor case housing (Figure 3)

Figure 3: Gyroscope rotor from the disassembled directional indicator



Examination of the gyroscope assembly from the electric turn coordinator revealed damage that was consistent with the gyroscope rotating at speed at the time of impact.

An emergency locator transmitter (ELT) was installed in the aircraft's fuselage. However, the ELT was destroyed by impact forces and the unit was not capable of transmitting a distress signal.

Survival aspects

Due to the extent of the impact forces and the break-up of the aircraft, the accident was not survivable.

Tests and research

A sample of fuel was obtained from the refuelling equipment at Warburton that was used to refuel the aircraft. An analysis of that sample confirmed that the fuel complied with the relevant standard for AVGAS 100/130.

Further investigation

The investigation is continuing and will include further examination of a number of components that were recovered from the accident site, including the vacuum relief valve.