Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Investigation – AO-2007-029

Preliminary

In-flight break-up – Clonbinane, Vic. – 31 July 2007

VH-YJB

Rockwell Commander 500S

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Google Earth for the image in Figure 1

Abstract

On 31 July 2007, a Rockwell Commander 500S, with a pilot and passenger on board, was making a night, instrument flight rules, business flight from Essendon Airport, Vic. to Shepparton. While cruising at 7,000 ft and approximately 25 NM (46 km) north-north-east of Essendon, the aircraft disappeared from radar. Attempts by the controller to contact the pilot were unsuccessful. Later that night the aircraft wreckage was found in timbered ranges near the last radar position. There were no survivors.

Wreckage was distributed over a considerable area and the outer wing sections and the tail had separated in flight. Subsequent wreckage reconstruction and examination of the fracture surfaces found no evidence of contributory fatigue cracking, pre-existing defects or structural corrosion.

At the time of the occurrence there was a north to north-westerly wind of 40 kts or greater in the area. The Bureau of Meteorology had issued two concurrent SIGMET warnings for the period of the flight. The first warned of severe mechanical turbulence over and south of the ranges, and the second warned of occasional severe mountain wave turbulence.

The Preliminary report contains factual information that has been obtained for the investigation to date and describes the focus of further investigations.

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.

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

History of the flight

On 31 July 2007, a Rockwell International Aero Commander 500S, registered VH-YJB, departed Essendon Airport, Vic. at 1946 Eastern Standard Time[1] on a flight to Shepparton, Vic. The business flight was conducted under the instrument flight rules (IFR) and on board were a pilot and one passenger. At 2000, while tracking from Essendon to Shepparton at 7,000 ft above mean sea level and in Class C airspace, radar and radio contact was lost simultaneously when the aircraft was about 25 NM (46 km) north-north-east of Essendon. The controller declared a distress phase while attempting to make contact with the pilot. At 2008, the Operations Director at Melbourne Centre declared YJB as probably lost and advised AusSAR[2]. A search was commenced using rotary and fixed-wing aircraft in addition to ground search parties. No emergency locator transmitter signal was reported. At approximately 2200, searchers found the wreckage of YJB in timbered ranges north of Melbourne. There were no survivors.

The flight was arranged to take the company owner, a licensed aircraft maintenance engineer, to Shepparton to replace an unserviceable starter motor in another of the operator's aircraft. The pilot, who had landed at 1916 from a previous flight in another of the operator's aircraft, was tasked to fly the owner to Shepparton. The pilot transferred to YJB which had been previously prepared for flight by another pilot.

At 1938, while taxiing for takeoff, the pilot advised the aerodrome controller of the intention to conduct the IFR flight, adding, '…and request a big favour for a submission of a flight plan, with an urgent departure Essendon [to] Shepparton [and] return'. The aerodrome controller did not have the facilities for processing flight notifications and sought the assistance of a controller in the Melbourne centre.

A copy of the operator's standard flight log[3], incorporating the Essendon to Shepparton sector, was found in the wreckage. It contained pre-computed time intervals and fuel figures, but no actual fuel quantity. The aircraft's previous flight log showed 294 litres of Avgas remaining and the operator's fuel documents recorded that 191 litres were added after that flight. Employees reported that the operator's aircraft were normally refuelled to a quantity of approximately 480 litres to be always ready for any of the scheduled freight services. They also reported that the only items that the owner took with him were his tool kit and a replacement starter motor.

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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.

2 AusSAR is the Australian search and rescue agency.

3 Flight logs were, produced for each of the operator's routes, and incorporated the pre-computed flight plan, a fuel log, duty times, flying times and maintenance times. The flight log used for the flight to Shepparton was for the scheduled route from Essendon to Shepparton, Swan Hill, Bendigo and Essendon.

Radar data

The Australian Advanced Air Traffic System (TAAATS) processes and records radar signals from multiple surveillance sensors and correlates the information to produce synthesised aircraft tracks that are presented to air traffic controllers on an air situation display. The system records the information from each sensor as local track data and the synthesised track as system track data. The aerodrome controller issued a secondary surveillance radar (SSR) discrete code of 4251 to the aircraft for the flight. The pilot read back that code as part of the confirmation of the airways clearance for the flight.

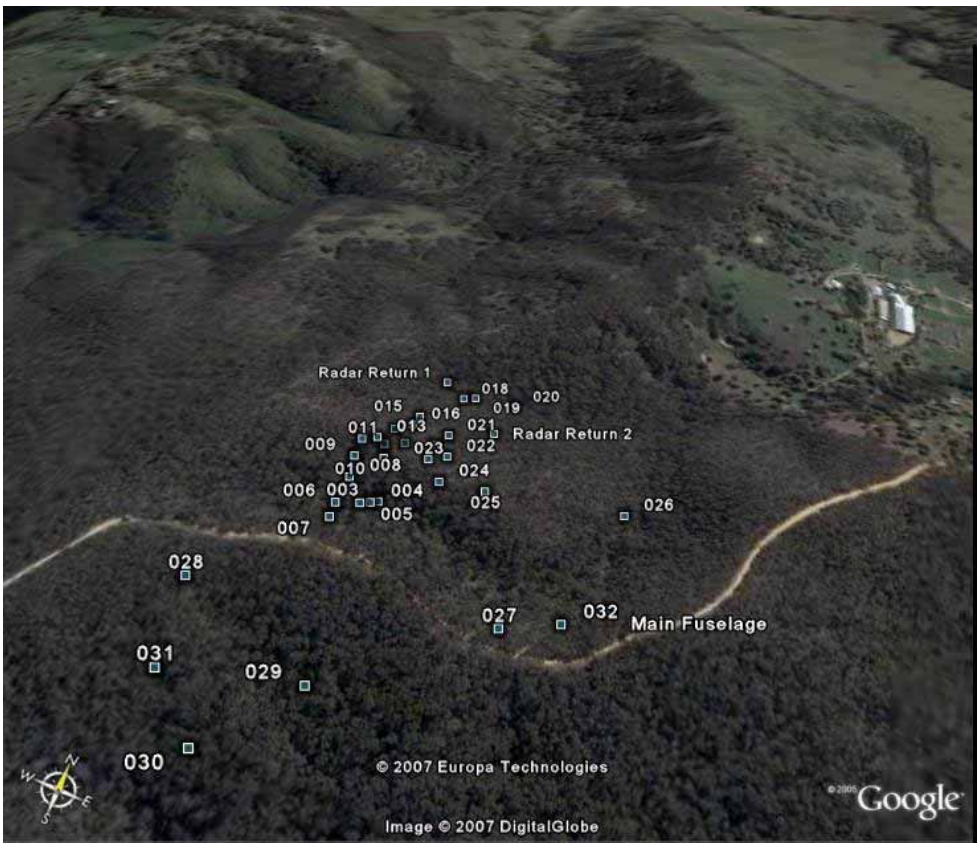
The flight was tracked by the Melbourne terminal area radar (TAR) sensor at Gellibrand Hill, capable of detecting both primary radar returns reflected from the aircraft, and SSR returns from the aircraft's transponder signals, which included Mode C altitude information. The route surveillance radar (RSR) sensor at Mt Macedon received SSR information only. Both sensors swept the coverage area every 4 seconds.

The radar data was examined and showed that the aircraft climbed to a Mode C altitude of 7,000 ft at ground speeds between 80 and 120 kt. The aircraft then maintained a consistent altitude of 7,100 ft for nearly 5 minutes, with groundspeed gradually increasing from 122 kt to 144 kt. From 0957:42, there was altitude variation between 100 and 200 ft from the planned cruising altitude and a gradual decrease in groundspeed from 144 to 140 kt. At 1958:37 the aircraft turned right sharply on to a south-easterly track. The system indicated 'INVALID' Mode C altitude information, which is the default mode when a target's vertical speed exceeds 9,000 feet per minute. The subsequent returns were primary radar signals that did not contain useable altitude information. The flight path tracked by the primary radar showed a further right turn on to a north-westerly heading, then several more returns on a southerly track before ceasing at a position just to the north of where the main section of wreckage was located.

Witnesses

There were no witnesses to the last moments of the flight. Residents living in the vicinity of the accident site were inside their homes and reported difficulty hearing above the noise made by the wind and foliage being blown about. One of the residents reported hearing a brief loud engine noise. Another resident thought the noise was that of a noisy vehicle on the road. The noise was described as being constant, '…not spluttering or misfiring' and lasted for only a few seconds. Some of those residents near the accident site reported hearing and feeling an impact only moments after the engine noise ceased.

Figure 1: Accident site, showing the distribution of the wreckage and the position of the last two radar returns



Accident site and wreckage

The main section of wreckage was located at 37º 21 39´S, 145º 05 92´E in timbered, hilly terrain at an elevation of approximately 1,400 ft (Figure 1). The accident was not survivable. The main section of wreckage had descended almost vertically through the tree canopy and impacted the sloping ground in a flat, inverted attitude (Figure 2). There was no fire. The outboard section of both wings from approximately the aileron/flap junction, the rear fuselage, tail cone and empennage, and the aft cargo door had separated from the aircraft and were later located north and west of the main wreckage at distances up to 700 m. The wreckage distribution was consistent with the aircraft having broken up in flight, prior to impacting the terrain.

The investigation was unable to determine with any certainty, the pre-impact position of the power levers and aircraft ancillary controls. There was evidence to show that the flaps and landing gear (in particular broken up-lock hooks) were retracted at impact. The replacement starter motor and tools were found strewn on the ground near the main wreckage, consistent with them having been ejected from the aircraft's rear locker at impact with the terrain.

Figure 2: Main section of wreckage

Weather

A Bureau of Meteorology (BoM) forecast for Areas 30 and 32[4], valid for a 12-hour period from 1500, indicated strong and gusty northerly winds to prevail ahead of the passage of a cold front. North to north-westerly winds of 40 kts up to an altitude of 10,000 ft were forecast. Severe turbulence and mountain wave activity were expected as a result of the vigorous northerly flow. The front was not forecast to pass through the area until 0300 the next morning. Isolated thunderstorms associated with the passage of the front were forecast over the sea, in the southern part of the forecast area. The freezing level was between 6,500 ft in the south-west, grading to 8,000 ft in the north-east.

A SIGMET[5] (ML02), associated with the forecast, and valid from 1800, extended the validity of an earlier issued SIGMET (ML01) that forecast severe turbulence below 8,000 ft near and south of the ranges. Concurrently, another SIGMET (ML03), issued at 1727 and valid from 1800, warned of occasional severe mountain wave turbulence in the area between 5,000 ft and FL140, with intensity increasing.

Bureau of Meteorology forecasters advised that the existence of concurrent SIGMET information in the same area resulted from different meteorological phenomena associated with the strong wind. The first (ML02) warned of mechanical turbulence over and in the lee of the ranges and the second (ML03)

4 The Bureau of Meteorology provides en route aviation forecasts up to an altitude of 18,500 ft for specified areas. The forecasts are named for their area and their period of validity.

5 SIGMET information provided by the Bureau of Meteorology concerning potentially hazardous or extreme meteorological conditions which may affect the safety of aircraft.

warned of mountain wave activity within the air mass and covered a similar broadly defined area. The BoM advised that the existence of concurrent SIGMET warnings of turbulence could not necessarily be interpreted as having an accumulative affect in the overlapping areas and altitudes.

Two pilots flying other company Aero Commander aircraft landed at Essendon within the 30 minutes prior to the departure of YJB for Shepparton. Neither pilot reported encountering any significant turbulence except on final approach. Pilots arriving or departing from the Melbourne area at the time of the accident reported actual wind speeds in excess of 40 kts, but none experienced any significant turbulence. The crew of a fixed-wing search aircraft reported that in the wreckage area, there was significant, continuous turbulence at altitudes between 5,000 and 6,400 ft during the search. They reported the cloud as broken (5 to 7 OKTAS[6]), between 3,500 and 6,000 ft.

Surface wind gusts to 50 kts were reported on the ranges during the afternoon. Residents living near the accident site reported very strong wind conditions, of the kind experienced on only a few occasions a year. They reported that at the time of the accident there was bright moonlight, even with the frequent cloud movement obscuring it. Conditions were reported as clear and there was no precipitation.

Pilot

The pilot held a Commercial Pilot (Aeroplanes) Licence, issued on 25 February 1993, and endorsed for the Aero Commander class of aeroplane. Additionally, the pilot held a Command (Multi-engine Aeroplane) Instrument Rating that was valid until February 2008. Since obtaining that rating in June 2000, the pilot had recorded nearly 200 hours of instrument flight time. The pilot's Class 1 medical certificate was valid until April 2008 and required the holder to wear correction for distance vision and for reading. The pilot was not reported to have any illnesses and was described as being in 'good health and with a positive outlook'. The ATSB is awaiting the results of the post-mortem and toxicology testing.

The pilot had a total flying time of 2,318 hours, of which 970 were on type. The pilot's Aero Commander experience had almost all been accumulated flying scheduled freight services for the operator since May 2005. All but 9 months of that flying had been conducted from the operator's Essendon base and the pilot was familiar with the route, the terrain and the seasonal meteorological conditions. Prior to commencing the flight to Shepparton, the pilot had flown 4 hours that day. The flight was the pilot's first in the accident aircraft, YJB.

The pilot had been off-duty for the previous 4 days and had returned to work that morning. That off-duty period had been spent in the country away from Melbourne. Two days before the accident, the pilot had returned to Melbourne by car, a reported 8-hour drive. The pilot's activities on the previous day were not known, but friends reported that the pilot would have attended to domestic duties and studies.

The pilot commenced duty that morning at 0630 for a rostered, scheduled freight service to Mildura, Vic. At 1030, the pilot commenced a rest period between the

6 OKTA is a unit of the sky covered by cloud expressed as an eighth of total amount of the celestial hemisphere.

split duty periods at the company-provided motel accommodation. Motel staff reported that the pilot spent the time studying and sleeping until recommencing duty at 1630 for the return flight to Essendon, and that during the day the pilot had eaten a hot meal.

Company pilots reported that before making the return flight from Mildura, it was normal practice to obtain the latest NOTAM[7] and weather information by having the briefing office forward that information to the motel facsimile. The latest SIGMET, (ML03) was issued at 1727, 2 minutes after the pilot departed Mildura. Recorded audio data from air traffic control revealed that at 1759, a controller broadcast the relevant elements of SIGMET ML03 on a sector frequency. At the time, the pilot would have been 10 minutes from arrival at Horsham and monitoring that frequency. There were no recorded pilot reports of turbulence on the sector frequencies that afternoon.

Aircraft

The aircraft was manufactured by Rockwell International in the US in 1977, and given the manufacturer's serial number 3299. It had been imported into Australia from the US by the operator approximately 6 months earlier and following an Import Certificate of Registration inspection, was placed on the Australian register in February 2007.

The aircraft maintenance release was issued on 18 May 2007 and under the operator's approved system of maintenance, was valid for a period 12 months or 150 flight hours, whichever came first. The daily inspection certificate recorded a total time in service of 4,557.8 hours. It was maintained in accordance with regulatory requirements for a Class B aircraft. There were no recorded defects on the maintenance release and the pilot who last flew the aircraft reported there were no unserviceable items.

The aircraft was approved for flight under the IFR and was equipped with an EDO AIRE Mitchell Century III autopilot. It was not equipped for flight in known icing conditions.

Examination of airframe components

Thirty-two discrete airframe sections and components were recovered from the accident site and transported to a covered facility for detailed examination (Figure 3). Those components included the two outer wing sections and ailerons, the empennage including tailplanes and control surfaces, the left engine nacelle rear fairing and the rear cargo compartment door.

7 Notice to Airmen provide information on the condition or change in aeronautical facilities and/or hazards.

Figure 3: Part of the wreckage reconstruction

Both left and right outer wings had separated from the airframe at symmetric locations, coincident with the outboard flap / aileron transition. There were comparable levels of mechanical deformation of the upper and lower main spar elements (Figures 4 and 5) at the point of separation, consistent with the failure of both outer wing sections under downward bending loads. Similar downward bending characteristics were also exhibited by the wing rear spar elements.

Figure 4: View of the left wing main spar and surrounding fractures

None of the failed wing main structural load-bearing elements showed any evidence of cracking, corrosion or other pre-existing defects. All fracture features were typical of ductile tensile or shear failure under elevated stresses.

Figure 5: View of the right wing lower spar cap fracture surfaces

The aircraft empennage had separated from the main fuselage along a downward, diagonal plane, extending from the forward transition region between fuselage and vertical stabiliser. Fuselage skin and longerons[8] had torn and fractured in a manner consistent with exposure to the stresses associated with the break-up of the aircraft. Separation of the vertical stabiliser structure from the horizontal stabiliser and tail-cone had occurred at a location coincident with the forward horizontal stabiliser spar, with all fractures and surrounding regions showing no evidence of pre-existing anomalies.

All elevator, rudder and aileron control surfaces had separated from their primary structure during the break-up sequence. In all instances, the surfaces were liberated through the fracture or structural failure of the hinge points. Most surfaces had also folded and torn through the central span regions. All examinable control mechanisms and components displayed mechanical damage associated with the forceful separation from the primary structure.

Impact and break-up signatures

The under-surfaces of both separated outer wing sections presented impact signatures and witness marks that were consistent with having struck the leading edges of the respective horizontal stabilisers. Similarly, the underside of the separated left engine nacelle rear fairing displayed damage that attested to an impact with a section of the left outer wing leading edge.

Within the main aircraft fuselage, several sharp, outwardly oriented indentations and punctures were consistent with repeated impacts from the aircraft's main battery, which had broken free from its mounts but remained electrically connected. A characteristically stretched and elongated filament within a wing tip navigation light globe was further indication of the magnitude of forces sustained during the wing separation.

8 Principal longitudinal structural members in the fuselage.

Examination of engines and propellers

The engines and propellers were removed and examined at specialist facilities. Those examinations did not reveal any pre-existing defect or malfunction that would have affected normal operation at the time of the in-flight break-up.

Further investigation

The investigation is continuing with:

- an examination of instruments and auto-pilot components
- analysis of the radar data
- analysis of gust loadings
- a review of the meteorological phenomena associated with wind shear and mountain wave turbulence in the area.