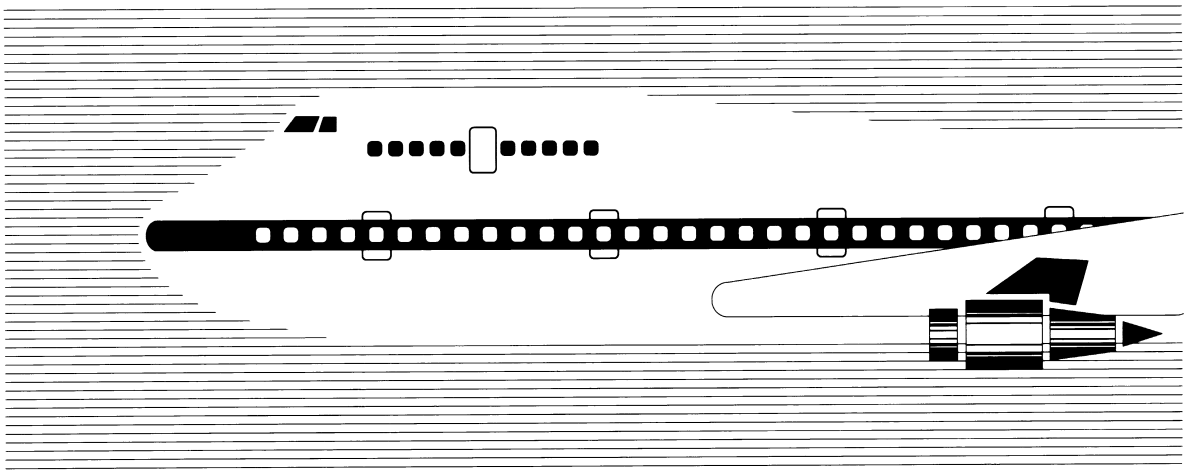
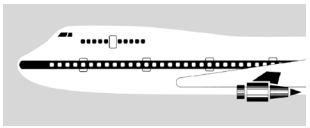
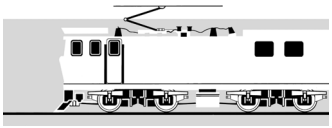


AVIATION OCCURRENCE REPORT

03-002	**Report 03-002, Cessna U206G ZK-EJG, engine failure after take-off, Ardmore Aerodrome**	**2 February 2003**





TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 03-002

Cessna U206G

ZK-EJG

engine failure after take-off

Ardmore Aerodrome

2 February 2003

Abstract

On Sunday 2 February 2003 at 1656, ZK-EJG, a Cessna U206G, took off from runway 21 at Ardmore Aerodrome bound for Waiheke Island. On board were the pilot and 2 passengers. After entering a left turn at about 600 feet, there was a sudden and total loss of engine power and the engine stopped. The pilot was able to continue the turn to position and land safely on the reciprocal runway. There were no injuries or further damage to the aircraft.

The engine stopped because 2 connecting rods broke, punctured the engine casing and seized the engine.

Regular technical analysis of the engine oil may have detected the impending failure of the connecting rods and their bearings.

Contents

Figures

Data Summary

Aircraft registration:	ZK-EJG
Type and serial number:	Cessna U206G, U20603549
Type and serial number of engine:	Teledyne Continental IO-520-F, 286408R
Year of manufacture:	1976
Operator:	Waiheke Air Service Limited
Date and time:	2 February 2003 at 1657[1]
Location:	Ardmore Aerodrome latitude: 37° 01.8′ south longitude: 174° 58.4′ east
Types of flight:	air transport, charter
Persons on board:	crew: 1 passengers: 2
Injuries:	nil
Nature of damage:	engine and minor to cowling
Pilot's licence:	commercial pilot licence (aeroplane)
Pilot's age:	23
Pilot's total flying experience:	1354 hours (98 on type)
Investigator-in-charge:	I R M^{c}Clelland

[1] Times in this report are New Zealand Daylight Time (coordinated universal time (UTC) + 13 hours) and are expressed in the 24-hour mode.

1 Factual Information

1.1 History of the flight

1.1.1 On Sunday 2 February 2003, the pilot of ZK-EJG, a Cessna U206G, was assigned to fly a round trip from the operator's base on Waiheke Island to Great Barrier Island, Ardmore and back to Waiheke Island. The weather was reported as fine and suitable for the flights.

1.1.2 The pilot reported for duty at 1430 and completed a pre-flight inspection of ZK-EJG. The pilot observed that the engine oil quantity was low and, after informing the owner, one quart of oil was added to bring it up to the required level. A flight plan was filed with air traffic services in preparation for the flights. The 4 passengers for the first leg to Great Barrier Island arrived at the aircraft at about 1500 and were given a safety briefing by the pilot before being boarded. The pilot started the aircraft, completed an engine run-up and check, and departed for Great Barrier Island. The flight proceeded normally.

1.1.3 At Great Barrier Island the pilot shut down the engine, disembarked the 4 passengers and briefed the next group of 5 passengers, 3 of whom were for Ardmore and 2 for Waiheke Island. The pilot restarted the aircraft after about 15 minutes and departed for Ardmore. The flight was again uneventful.

1.1.4 At Ardmore Aerodrome the pilot shut down the engine, disembarked the 3 passengers and their luggage, started the aircraft and taxied for take-off on runway 21. Because it had been only a short time since the last flight, about 10 minutes, and the engine was still warm, the pilot did not complete a second engine run-up and check, nor was she required to.

1.1.5 After waiting for a preceding aircraft to depart, the pilot lined ZK-EJG up on runway 21 and took off normally using full power. After take-off the pilot raised the flaps, set climb power and extended into wind slightly before entering a left turn at about 600 feet to head towards Waiheke Island. The pilot reported hearing the engine start to run rough shortly after entering the turn. This was quickly followed by a loud "clunk", and the propeller stopped rotating. The pilot saw a film of oil on the windscreen.

1.1.6 The pilot put ZK-EJG into a glide, continued the left turn and looked for suitable areas to land. The pilot made a distress call informing local traffic and advised she was turning back towards the runway. The duty aerodrome communication service person in turn directed other aircraft clear of the runway and approach areas. The pilot was able to make an approach on the reciprocal runway, runway 03, and landed ZK-EJG about halfway down its length, coming safely to a halt near the end. The aircraft was towed clear of the runway area to a nearby hangar, where it was held to await the arrival of the Commission's investigator. There were no injuries.

1.2 Personnel information

1.2.1 The pilot, aged 23, held a Commercial Pilot Licence (Aeroplane) and a Class 1 Medical certificate valid until 15 November 2004. She was rated on the Cessna 206 and had flown over 1354 flying hours, including 98 hours on ZK-EJG. Her last competency check was on 9 December 2002.

1.2.2 The pilot had flown about 115 hours in the previous 90 days, including about 17 hours on ZK-EJG. About 50 hours were flown for the operator during this time.

1.2.3 The pilot was based on Waiheke Island and had flown for the operator for about one year. The pilot last flew on about 28 January 2003, 4 days before the incident.

1.3 Aircraft information

1.3.1 ZK-EJG was a Cessna U206G single-engine aeroplane, serial number U20603549, constructed in the United States in 1976. The aircraft was fitted with 6 seats and powered by a Teledyne Continental IO-520-F engine, serial number 286408R.

1.3.2 The aircraft had been issued with a non-terminating Certificate of Airworthiness in the standard category and was recorded as being maintained in accordance with the manufacturer's specifications. The last inspection was a 50-hour "OPS 3" inspection completed on 6 January 2003 at 6706 aircraft hours and 1587 engine hours. The aircraft had flown a further 8 hours before the accident and so had another 42 hours to fly before the next scheduled inspection. The next annual review of airworthiness was due 25 May 2003.

1.3.3 The engine was rebuilt by the manufacturer at the beginning of 1993 and installed in ZK-EJG in April of the same year. The engine had about 105 hours to run before its next major overhaul, which was required at 1700 hours. Records showed that the oil was changed as part of every 50-hour servicing and was of the correct specifications. No additives were used and the waste oil was not subjected to technical analysis.

1.3.4 The operator purchased ZK-EJG in March 1996 for air transport charter work around Hauraki Gulf and Coromandel Peninsula, and it typically flew about 130 hours per year. The aircraft was based at Waiheke Island and when not flying was secured in a hangar on the island. During 2001 and 2002 the operator had to complete repairs to most of the 6 cylinders and replaced 2 cylinders because of cracks and high compression leak rates. Changes to engine management procedures for ZK-EJG in 2002, in particular aircraft descent profiles and power changes, resulted in a reduction in the incidence of cylinder repairs.

1.4 Tests and research

1.4.1 The engine was removed from ZK-EJG for examination by an approved engine overhaul facility under the supervision of the Commission. There were 2 puncture holes in the engine crankcase, in line with numbers 1 and 2 cylinders. The left magneto, in line with the number 2 cylinder, had been dislodged and part of a connecting rod was protruding through the puncture hole.

1.4.2 The crankcase was opened and oil and metal debris fell clear. The quality of the oil was consistent with having been in the engine for about 8 hours of operation and appeared to be fit for purpose.

1.4.3 The number 1 connecting rod was found to have broken at the big end, and the caps for both numbers 1 and 2 rods had separated. All internal components for the engine were accounted for, including the caps, bearings, retaining bolts and nuts for the 2 broken rods.

1.4.4 Examination of the retaining bolts for the numbers 1 and 2 connecting rods confirmed they all had failed due to gross overload. The adjoining faces of the big ends and caps displayed galling or rubbing marks and some deformation.

1.4.5 The 4 bearing shells from numbers 1 and 2 connecting rods had all been deformed to varying degrees and their original location could not be confirmed (see Figure 1). The least deformed bearing displayed rubbing marks on its inside surface and had been impacted and splayed out near the centre. The number 3 connecting rod bearings displayed similar marks, with the bearing that was adjacent to the cap (cap bearing) also splayed out at about its centre (see Figure 2). Number 4 connecting rod cap bearing also displayed the same type of damage but again to a lesser degree than the number 3 cap bearing. The number 5 and 6 bearings were not deformed but the number 5 cap bearing did have some rubbing marks on the inside of the bearing.

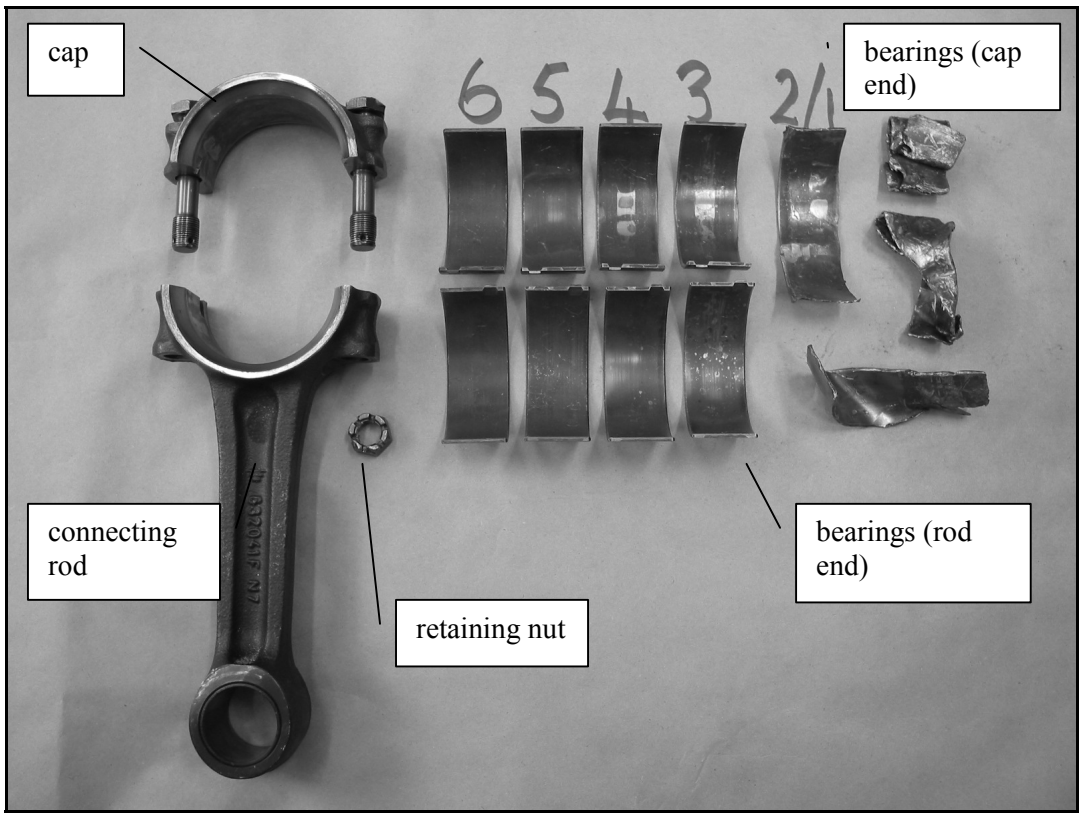


Figure 1
Connecting rod and shell bearings from ZK-EJG

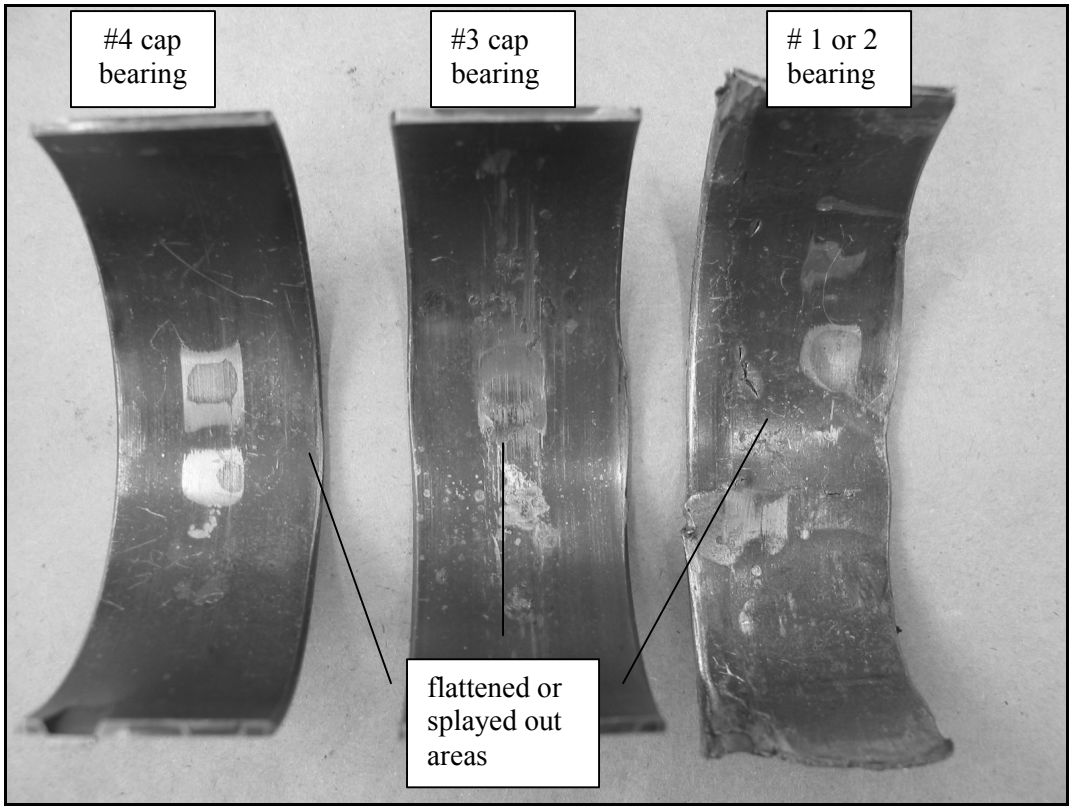


Figure 2
Cap bearings

2 Analysis

2.1 The flights were part of a routine run between the various destinations in the Hauraki Gulf and proceeded normally until the engine stopped shortly after take-off from Ardmore Aerodrome. There was no warning to the pilot of the imminent failure and her prompt actions prevented any injury or further damage.

2.2 The aircraft was maintained and flown in accordance with the operator's specifications. The change in operating procedures in 2002, concerning engine handling, resulted in an improvement in the maintenance history of the engine.

2.3 The stoppage resulted from the caps for either number a failure of the big end of number 1 connecting rod or the caps from numbers 1 and 2 rods separating. The condition of the bearings for these 2 rods, and also the remaining rods, could indicate that the separation was initiated by a failure of a bearing; this led to excessive stress on a connecting rod and cap. Alternately, the stoppage could have been a direct result of a failure of a connecting rod, cap or a retaining bolt and nut, and not related to the bearings. However, there was no evidence of fatigue on any of these items, but the level of damage sustained may have erased any fracture surfaces.

2.4 The galling on the abutting faces of the caps and rods confirm that there was some movement of the caps before separation. This could explain the impact marking and splaying out of the cap bearings. Equally, the condition of the bearings may have been due to a breakdown in the lubrication of the parts. This could have resulted from contamination of the oil, for example through ingestion of foreign matter during operation, a blockage of oilways, or possibly from inappropriate handling. The inadequate lubrication could have resulted in the rubbing of the bearings, especially the cap bearings. The cap bearings then became impacted and splayed out, resulting in their failure.

2.5 The changing of the engine oil at every 50 hours inspection should have removed most contaminates that were not caught by the filter. Large and rapid power changes can result in thermal stress to parts of the engine, for example the cylinders. This could also overheat the oil and cause a reduction in its lubricating qualities. By restricting power changes thermal stress is reduced and engine wear improved. However, for both these scenarios, once damage to a bearing had occurred there was likely to be a steady degradation until failure.

2.6 The condition of the bearings was consistent with the wear occurring over a long period of time, possibly several hundred engine hours. While cracked or leaking cylinders can result from short flights with large and rapid power changes, they do not necessarily result in a catastrophic breakdown of lubrication to the connecting rods and bearings.

2.7 The origin of the failure could not be conclusively determined but could be attributed to several possible causes, including: material failure, manufacture, contamination, mishandling or a combination of these. Given the period over which the condition of the bearings degraded, the impending failure might have been detected by regular technical analysis of the engine waste oil. At the time of this accident testing of engine oil was at the discretion of the owner or operator; the testing of oil from turbine engines being more common. However, for a cost of about $35 per test the oil from ZK-EJG could have been tested and a possible fault identified before catastrophic failure occurred.

3 Findings

Findings are listed in order of development and not in order of priority.

3.1 The pilot was appropriately qualified and experienced for the flight.

3.2 The flight was being conducted in a normal and routine manner.

3.3 Shortly after take-off, the caps for 2 connecting rods separated and the engine suddenly stopped.

3.4 The pilot's actions after the stoppage were timely and appropriate, and prevented injury and further aircraft damage.

3.5 A specific cause for the failure of the cap for either number 1 or number 2 connecting rods could not be determined and might have been the result of a combination of factors.

3.6 The damage to the bearings or connecting rods possibly occurred over a long time and technical analysis of the oil might have identified the progressive deterioration of the bearings and prevented the engine failure.

4 Safety Actions

4.1 The Civil Aviation Authority are actively informing operators and maintainers, through local seminars and training activities, of the capabilities and benefits of regular engine oil analysis.

Approved for publication 24 September 2003

Hon W P Jeffries
Chief Commissioner

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01-012	Robinson R44 Astro, ZK-HTK, collision with terrain, Urewera National Park, 3 December 2001
02-001	Cessna 207, ZK-SEV, collision with terrain, Gertrude Saddle area 11 km southeast of Milford Sound, 19 January 2002

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