Australian Government
Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Aviation Occurrence Report – 200700357
Interim Factual

Engine failure – 28 km WSW of Warialda, NSW
2 February 2007
VH-HRT
Bell Helicopter Company 407

Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT

Aviation Occurrence Report
200700357

Interim Factual

Engine failure
28 km WSW of Warialda, NSW
2 February 2007
VH-HRT
Bell Helicopter Company 407

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office location: 15 Mort Street, Canberra City, Australian Capital Territory
Telephone: 1800 621 372; from overseas + 61 2 6274 6440
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117; from overseas + 61 2 6247 3117
E-mail: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

ISBN and formal report title: see 'Document retrieval information' on page iii.

DOCUMENT RETRIEVAL INFORMATION

Report No.	Publication date	No. of pages	ISBN
200700357	18 September 2007	12	978-1-921165-22-1

Publication title

Engine failure - 28 km WSW of Warialda, NSW, 2 February 2007, VH-HRT, Bell Helicopter Company 407.

Prepared by

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

Reference No.

Sep2007/DOTARS 50355

Abstract

On 2 February 2007, at about 1530 Eastern Daylight-saving Time, a Bell Helicopter Company model 407 (B407) medical helicopter with a pilot, a crewman, a doctor and a paramedic on board departed Tamworth, NSW enroute to a car accident. At about 1610, the pilot broadcast on both the area and common traffic advisory frequency (CTAF) radio frequencies that they were inbound to Warialda at 28 km south-west and on descent from 6,500 ft above mean sea level. The pilot later reported that soon after the broadcast, the engine chip detector advisory capsule illuminated on the master caution panel. He reported that approximately 5 seconds later, he heard a loud noise and the helicopter developed a severe high frequency vibration with a complete loss of engine power. The pilot then broadcast a distress advisory on the area and CTAF frequencies with position, altitude, passenger information and the problem. During the ensuing autorotation emergency landing, the helicopter landed heavily and rolled onto its side. None of the occupants were injured, but the helicopter was destroyed. The investigation determined that the engine sustained an in-flight catastrophic failure of the engine accessory gearbox. The failure of the gearbox was determined to be a fracture and separation of a section of the helical torquemeter gear, which resulted in complete loss of engine power.

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.

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.

FACTUAL INFORMATION

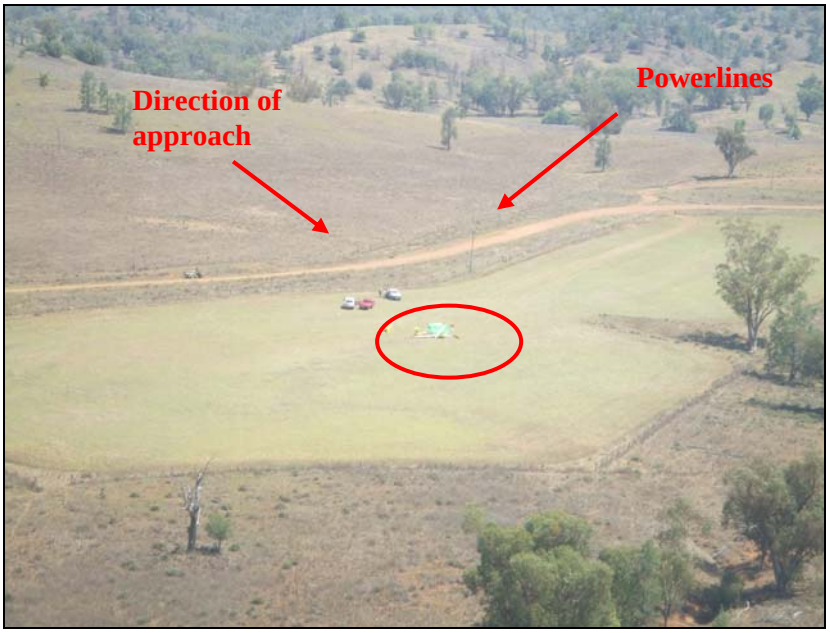
History of flight

On 2 February 2007, at about 1530 Eastern Daylight-saving Time[1], a Bell Helicopter Company model 407 (B407) medical helicopter, with a pilot, a crewman, a doctor and a paramedic on board, departed Tamworth, NSW enroute to a car accident. At about 1610, the pilot broadcast on both the area frequency and common traffic advisory frequency (CTAF) that they were inbound to Warialda at 28 km south-west and on descent from 6,500 ft above mean sea level (AMSL).

The pilot later reported that soon after the broadcast, the engine chip detector advisory capsule illuminated on the master caution panel[2]. He further reported that approximately 5 seconds later, he heard a loud noise and the helicopter developed a severe high frequency vibration with a complete loss of engine power. The pilot broadcast a distress advisory on the area frequency and CTAF with position, altitude, passenger information and the nature of the problem. He then informed all occupants that they would have to complete an autorotation emergency landing.

During the emergency landing, the helicopter sustained major damage and was later deemed to be uneconomical to repair. The elevation at the site of the emergency landing was about 1,100 ft AMSL (Figure 1).

Figure 1: Helicopter emergency landing site



1 The 24-hour clock is used in this report to describe the local time of day, Eastern Daylight-saving Time (EST), as particular events occurred. Eastern Daylight-saving Time was Coordinated Universal Time (UTC)+ 11 hours.

2 The engine chip detector advisory was a device, often a permanent magnet, for gathering every chip, usually from lube oil. When a metal chip was collected, the circuit was made continuous and the advisory capsule on the master caution panel illuminated indicating metal contamination internally.

The pilot later reported that when he checked the engine instruments following the loud noise he noted:

- 0 % engine torque
- 505º C measured gas temperature (MGT)
- 62.9 % engine gas producer speed (N1)[3].

The pilot reported that during the engine failure, he had attempted unsuccessfully to maintain the engine and Nr[4] at 100 %. The other occupants also noted that the Full Authority Digital Engine Control had illuminated two faults on the enunciator panel.

Helicopter weight and performance information

The helicopter certificated maximum take-off weight was 2,382 kg. The operator reported that the helicopter departed Tamworth with 850 lbs (386 kg) of fuel with an estimated total take-off weight of 2,289.5 kg. The pilot reported that the fuel usage of the helicopter until the time of the occurrence was 200 lbs (91 kg). The investigation estimated the total weight of the helicopter at the time of the occurrence as about 2,198 kg.

Wreckage examination

The helicopter was recovered to an authorised repair facility for further examination. At the time of the occurrence, the helicopter had completed 3,203.0 hours total time since new (TTSN). The front passenger's windscreen was broken and the landing gear was destroyed. The main rotor and tail rotor blades were heavily damaged by impact. The main rotor head assembly, main rotor transmission, tail rotor gearbox and all main and tail rotor drive components were removed for sudden stoppage inspection[5]. The helicopter tail boom and horizontal stabilisers were impact damaged and the tail section had separated. The helicopter skid-type landing gear was also heavily damaged (Figure 2).

3 N1 was a measurement of engine gas producer speed in RPM with 100 % representing 51,000 RPM.

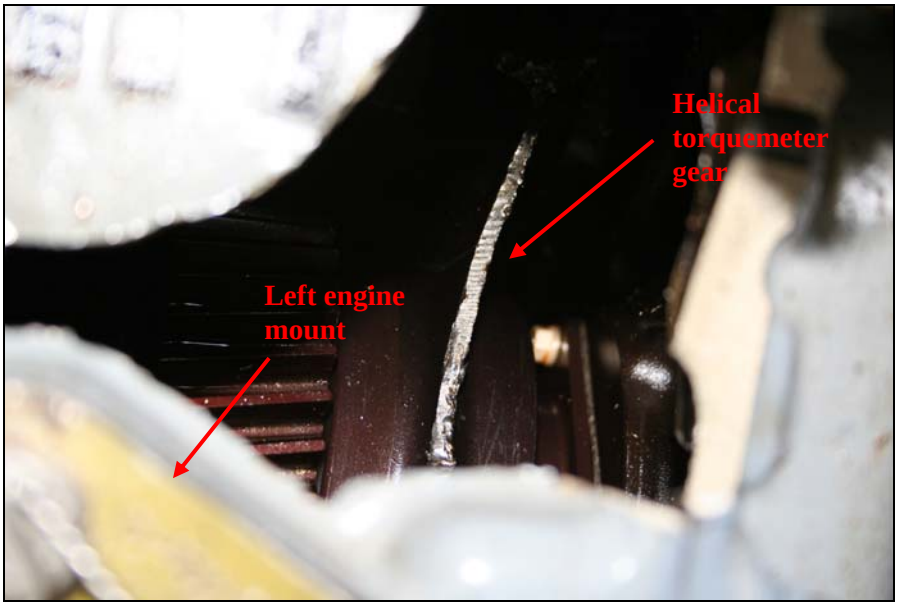
4 Helicopter main-rotor RPM.

5 Sudden stoppage of a dynamic component normally requires special inspection of the components using non-destructive testing and often results in unserviceability of the component.

Figure 2: Wreckage examination

The helicopter was powered by a single Rolls-Royce Corporation model 250-C47B turboshaft engine, part number 23063393, serial number CAG-47048. Initial examination of the engine accessory gearbox case revealed a 5 cm diameter hole in the case above the left side engine mounting pad. A section of the separated portion of the gearbox case was found on the engine deck, along with bearing material. The internal gear train components were visible through the hole, and it appeared that the gearshaft assembly helical torquemeter (helical torquemeter gear) had fractured (Figure 3).

Figure 3: Engine gearbox cover damage



The engine and electronic engine control unit (EEC) were removed from the helicopter and sent to an authorised repair facility for further examination under the supervision of the Australian Transport Safety Bureau (ATSB).

Engine examination

The engine disassembly and examination confirmed an internal catastrophic failure of the accessory gearbox, along with metal contamination of the engine sump and gearbox chip detectors and gearbox internally. Additional damage noted was to the:

- turbine shaft to pinion gear coupling
- N2[6] tachometer drive gearshaft and bearing
- teeth of the turbine shaft to pinion gear coupling.

Component examination

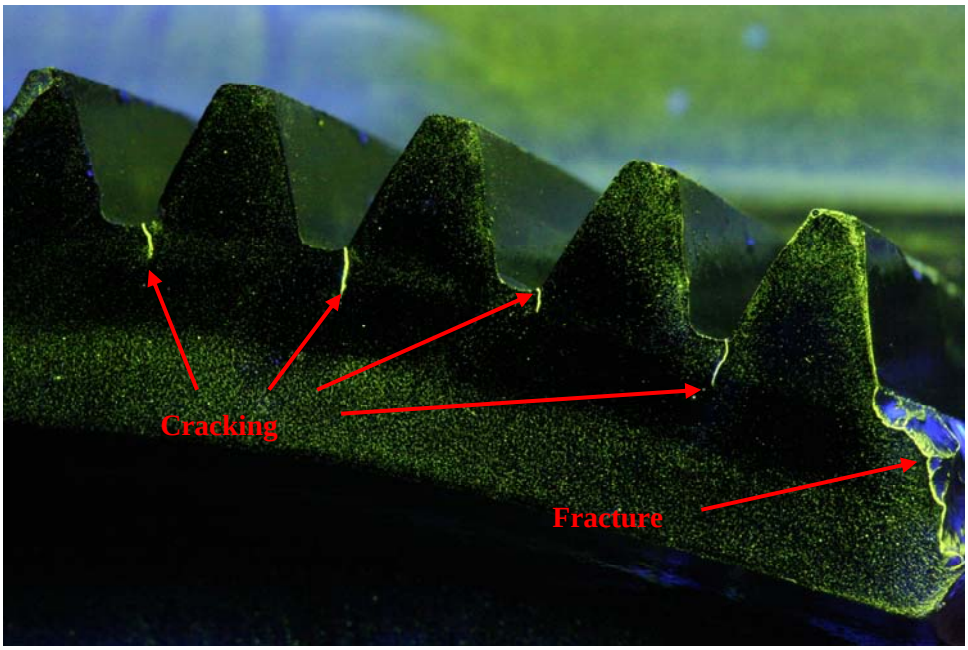
Preliminary examination of the part number 6893673, serial number NN143262 helical torquemeter gear confirmed that the component fractured through the rim and web sections, releasing two similarly sized segments (Figure 4).

Figure 4: Helical torquemeter gear examination

Fracture surface appearances suggested the failure had developed from the radial and chordwise growth of fatigue cracking from an origin at the root region of a rim gear tooth. Magnetic particle inspection showed evidence of cracking at the roots of several other gear teeth adjacent to the location of the fracture (Figure 5).

6 Power Turbine Speed (RPM).

Figure 5: Cracking at the roots of gear teeth



Evidence of localised gear tooth spalling and uneven surface contact patterns was also observed, suggesting a possible misalignment condition between the helical torquemeter gear and the N1 input spur adapter gearshaft.

The helical torquemeter gear had no retirement life assigned and was maintained in an ‘on condition’ basis.

Pilot informaton

The pilot held a commercial pilot’s licence (helicopter) and had accrued approximately 9,500 hours total experience, with 410 hours time on type and 56 hours on type in the last 90 days. The pilot reported that his last proficiency check was a base check completed with the operator’s chief pilot on 19 January 2007. The check included several auto-rotation emergency landings.

Weather information

The pilot reported the weather in the area as: temperature 28 º C, wind speed 10 kts (18.5 km/h)[7] from the south-east and no cloud. A routine weather observation for the nearby area for 1500 hours was:

- temperature 32.9 º C
- wind speed 17 km/h from the south-south-east
- relative humidity 28 %

7 Kilometres per hour.

- CAVOK[8]
- QNH 1014.5 hPA.

Using this weather information, the investigation calculated the density altitude at the emergency landing site at the time of the occurrence to be approximately 3,500 ft.

Engine and component history

At the time of the occurrence, the Rolls-Royce model 250-C47B engine, serial number CAE-847049 had accumulated 3,203.0 hours TTSN. The engine was the original engine installed in the helicopter when new. The last inspection of the engine occurred on 4 December 2006, at 3,146.4 hours TTSN, when a 150/300-hourly inspection was completed, which included cleaning and inspection of the fuel nozzle.

An examination of the engine and gearbox documentation noted that it had been previously repaired, with modifications installed, at an authorised repair facility.

Previous occurrences

The model 250-C30 series engine was similar in design to the model 250-C47B series engine and the part number 6893673 helical torquemeter gear was used in both models.

The engine manufacturer provided the ATSB with information on previous failures of the part number 6893673 helical torquemeter gear. Included in the information regarding model 250-C47B engines, were reports of three helical torquemeter gears submitted to the engine manufacturer with:

- wear and pitting on two gears with 400 and 1,834 hours TTSN respectively, with both exhibiting overheat indications and no teeth cracking
- spalling on one gear with 146 hours TTSN and no teeth cracking.

The engine manufacturer also advised that on 3 June 2007, a Canadian registered model B407 helicopter (with a model 250-C47 engine) sustained an in-flight engine failure and completed a successful autorotation emergency landing near Goose Bay, Labrador, Canada. The helical torquemeter gear in that engine gearbox had also failed. The ATSB is gathering further details from the engine manufacturer concerning that gear failure.

In 1981, a failure of a model 250-C30 engine helical torquemeter gear was also documented. The engine in that occurrence had accumulated 628 hours TTSN.

8 When the following conditions are observed or forecast to occur simultaneously; visibility of 10 km or more, no cloud below 5,000 ft, no cumulonimbus, and no significant weather.

Electronic engine control unit (ECU) information

The ECU was downloaded by a representative from the engine manufacturer under the supervision of the ATSB. The downloaded information included:

- a previously recorded engine torque exceedance[9]
- an Nr range fault logged on the ECU memory
- a 28 volt direct current alternator fault logged on the ECU memory about 2 seconds prior to the engine failure
- engine parameters appeared normal at the time of the engine failure
- engine parameter values reduced, as would be expected, following the engine failure.

Continuing examination

The investigation is continuing and will include examination of the:

- metallurgy of the occurrence helical torquemeter gear to ascertain compliance or otherwise of the component with the manufacturer's specifications
- overhaul and repair history of the occurrence engine gearbox and helical torquemeter gear
- previous occurrences of helical torquemeter gear failures.

9 The hours and date of the exceedance were not documented as no time stamp was associated with this event.