Australian Government
Australian Transport Safety Bureau

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ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence Investigation AO-2010-006
Preliminary

Total power loss, VH-NWO 11 Km NE of Derby, Western Australia 29 Jan 2010

Abstract

On 29 January 2010, at about 2010 Western Standard Time a single-engine Pilatus PC-12 aircraft, registered VH-NWO, was being operated on a medical evacuation flight from Derby to Kununurra, Western Australia with four persons on board. The flight was being conducted under the Instrument Flight Rules.

At a position about 30 NM (56 km) after takeoff, the pilot reported engine problems and turned the aircraft back to the departure aerodrome. The engine subsequently failed and the pilot glided the aircraft to the aerodrome and landed safely with no reported injuries. A subsequent inspection confirmed that the engine propeller reduction gearbox had seized.

The investigation found that a number of first-stage reduction gearbox carrier bolts had failed. As a result, the engine manufacturer has reviewed a number of issues relating to engine overhaul practices and has recommended withdrawal from service of an engine from one aircraft in the Australian fleet for examination.

The investigation is continuing.

FACTUAL INFORMATION

The information contained in this preliminary report is derived form initial investigation of the occurrence. Readers are cautioned that there is the possibility that new evidence may become available that alters the circumstances as depicted in this report.

History of the flight

On 29 January 2010, at about 2010 Western Standard Time[1] a single-engine Pilatus PC-12 (PC-12) aircraft, registered VH-NWO, was being operated on a medical evacuation flight from Derby to Kununurra, Western Australia with four persons on board. The flight was being conducted under the Instrument Flight Rules (IFR).

At a position about 30 NM (56 km) after takeoff, as the aircraft was climbing through flight level (FL)180, the pilot reported hearing a loud humming and whining noise for several seconds, before an engine chip detector warning light illuminated.[2] The pilot immediately turned the aircraft back towards Derby and transmitted a

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 Magnetic device that gathers metallic slivers, usually from lubricating oil. Those slivers complete an electrical circuit that illuminates a cockpit warning light.

PAN[3] call to Brisbane Air Traffic Control (ATC). Following the illumination of the 'Oil Quantity' light at FL 150/about 6 NM (11 km) from Derby, the pilot reported shutting down the engine and the propeller feathered and ceased rotating. The pilot then transmitted a MAYDAY[4] call to Brisbane ATC and continued with a glide approach. The aircraft landed safely at Derby and there were no reported injuries.

A subsequent maintenance inspection confirmed the seizure of the propeller reduction gearbox (RGB).

The PC-12 aircraft was approved for unrestricted day or night operations under the IFR. The occurrence took place at night, in visual meterological conditions, with smooth air and few clouds.

Engine and propeller information

Engine and propeller gearbox history

The aircraft was fitted with a Pratt and Whitney PT6A-67B engine, serial number PCE-PR0092. The engine was manufactured in Canada in June 1998, and had a Total Time In Service (TTIS) of 5,619 hours. The engine's power section[5] had 1,120 hours Time Since last Overhaul (TSO), which took place on 23 May 2007.

Engine examination

The engine was shipped to an approved Pratt and Whitney engine workshop for examination under the supervision of the Australian Transport Safety Bureau (ATSB). The examination of the propeller RGB revealed that four of the six first-stage reduction carrier bolts (part number MS 9490-34), had failed under the bolt heads due to fatigue cracking (Figures 1 and 2). As a result, failed bolt debris was released into the first-stage sun and planet gears, causing significant damage to those gears. Another carrier bolt had fractured through the threaded area, with the threaded portion remaining in the splined adapter.

The five fractured carrier bolts, including the first-stage carrier and the splined adapter have been retained by the ATSB for further specialist examination.

Figure 1: Location of failed bolts in the first-stage reduction of the propeller gearbox.

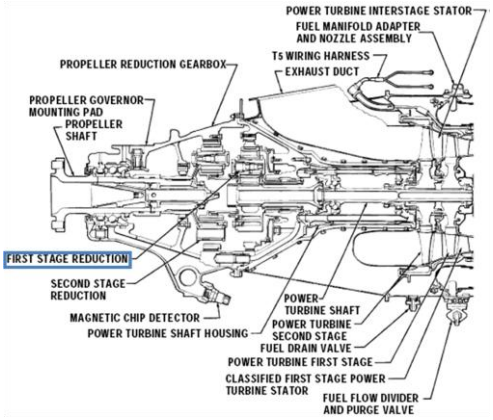
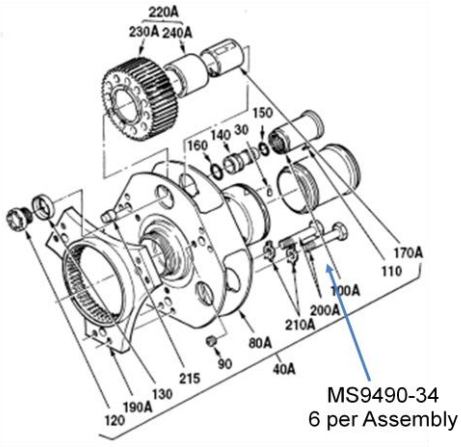


Figure 2: Location of failed bolts.



Service information

The investigation found that on 10 July 2008, Transport Canada issued a Service Difficulty Advisory (SDA) AL 2008-05 20, titled:

> PRATT & WHITNEY CANADA - PT6A-65 & 67 SERIES REDUCTION GEARBOX, 1ST STAGE CARRIER BOLTS FRACTURED.

3 Radio code indicating uncertainty or alert, general broadcast to widest area but not yet at the level of Mayday.

4 International call for urgent assistance.

5 Gas generator section of a turbine engine.

The SDA advised (in part):

> During the last several years, there have been over twenty reported fatigue fractures of the Reduction Gearbox (RGB) 1st stage carrier bolts, P/N MS9490-34. All but one of these incidents occurred following overhaul. At least five of the bolt failures caused in-flight shutdowns (IFSD).

An engineering evaluation conducted by Pratt & Whitney Canada (P&WC) at that time concluded that:

> ...inadequate bolt lubrication at assembly, coupled with a normal bending moment induced by the carrier under operation, can result in stress levels in the bolt that can exceed the endurance limit of the AMS5731 material.

The Transport Canada SDA further advised:

> P&WC has recently updated the respective engine overhaul manuals to re-emphasize the requirement to incorporate new 1st stage carrier bolts at overhaul and to lubricate the bolts on assembly. Additionally, P&WC has issued an All Shop Message PT6-2008-01 advising all PT6 overhaul agencies of the carrier bolt lubrication and torque requirements.

Transport Canada also recommended that all engine overhaul agencies remain current with, and adhere to all instructions issued by the type certificate holder.

Pratt & Whitney Canada advised the ATSB that between 2000 and 2010, there had been 27 RGB failures due to first stage carrier bolt head distress on large PT6A series engines. Similar gearbox configurations are common on a number of P&WC PT-6A-67 engine series. These include the PT-6- 67A/67AF/67AG/67B/67D/67P/67R and 67AR series engines. The worldwide fleet size for these series engines totalled 2,029 engines.

Of the 27 reported RGB failures, 15 resulted in in-flight shutdowns (IFSD). There were two in-flight events on PC-12 single-engine aircraft types. All of the failure events had occurred after engine overhaul, with no events associated with new production engines.

In 2007, P&WC initiated a further engineering study to better understand the reasons for the engine gearbox carrier bolt distress on the PT6A-67 series engines. As a result of this study, the following service changes were implemented:

- In January 2008, P&WC issued an 'All Shop Message' to all approved overhaul facilities to reinforce the existing standard practice for lubrication of the bolts and torque practices on critical components.
- In January 2009, P&WC revised the engine Overhaul Manual to introduce new torque procedures for the first stage carrier bolts as follows:

  > Lubricate the bolts MS9440-34 prior to installation at Overhaul.
  >
  > Apply torque twice during the assembly procedure to remove washer elastic reaction from the true bolt preload.

Ongoing investigation activities

The ATSB investigation is continuing and will:

- Conduct specialist examinations and analysis of the failed bolts.
- Evaluate data for previous similar failure events.
- Continue to work closely with P&WC and the Australian and International regulatory authorities to determine the continuing level of risk to similar PT6A-67 powered aircraft.

SAFETY ACTION

Pratt & Whitney Canada

Pratt and Whitney Canada (P&WC) has advised the Australian Transport Safety Bureau that it is undertaking a further detailed investigation of the PT6A-67 series of engines to better understand the carrier bolt distress mechanism. The preliminary information indicates that engine overhaul processes may be a contributing factor. Those processes, as well as several other identified issues, continue to be evaluated.

As a result of its continuing investigation into the reduction gearbox (RGB) failures, P&WC has recommended the removal from service of a low-time PT6A-67 series engine from one aircraft in the Australian fleet that was overhauled prior to the January 2009 overhaul revision. That engine will be examined with a view to confirming any issues with the RGB carrier bolts.